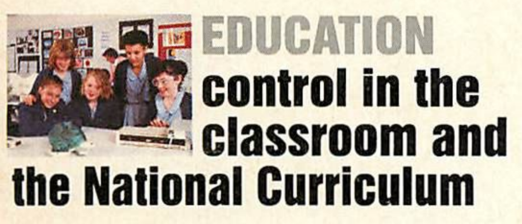
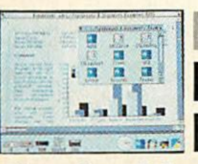
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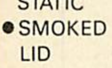
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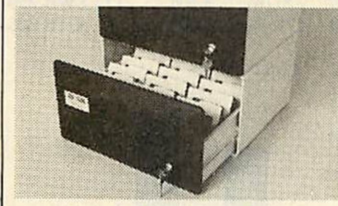
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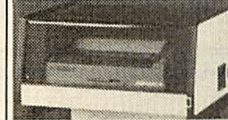
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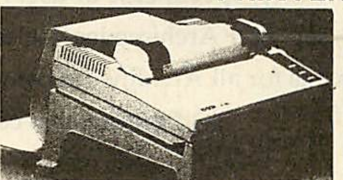
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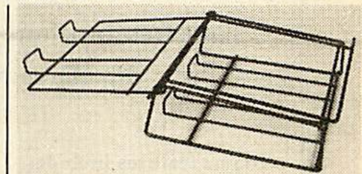
• SOFTWARE DRIVEN • KEYBOARD CONTROL

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KEYBOARDS

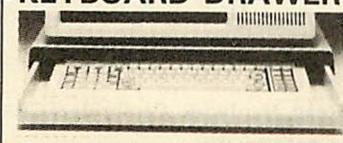
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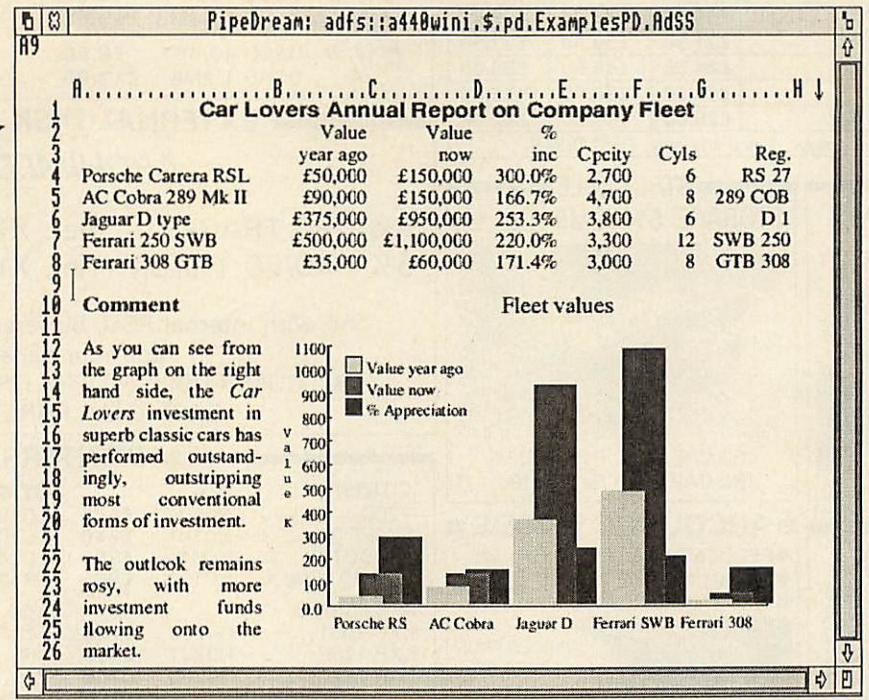
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PIPEDREAM 3





PipeDream: adfs::a440wini.$.pd.ExamplesPD.AdSS

A9

Car Lovers Annual Report on Company Fleet

	Value year ago	Value now	% inc	Cpcity	Cyls	Reg.
Porsche Carrera RSL	£50,000	£150,000	300.0%	2,700	6	RS 27
AC Cobra 289 Mk II	£90,000	£150,000	166.7%	4,700	8	289 COB
Jaguar D type	£375,000	£950,000	253.3%	3,800	6	D 1
Ferrari 250 SWB	£500,000	£1,100,000	220.0%	3,300	12	SWB 250
Ferrari 308 GTB	£35,000	£60,000	171.4%	3,000	8	GTB 308

Comment

As you can see from the graph on the right hand side, the *Car Lovers* investment in superb classic cars has performed outstandingly, outstripping most conventional forms of investment.

The outlook remains rosy, with more investment funds flowing onto the market.

PipeDream 3 breaks down the barriers between word processor, spreadsheet and database. You can include numerical tables in your letters and reports, add paragraphs to your spreadsheets, and perform calculations within your databases.

Based on PipeDream 2, the best-selling integrated package for the Archimedes, PipeDream 3 has been completely re-written to take full advantage of RISC OS - if you can use RISC OS, you can use PipeDream 3. It is fully multi-tasking and multi-windowing, so you can work on many documents at once and instantly move information between them. And since PipeDream 3 can automatically load and save most popular file formats, including VIEW and First Word Plus, switching to it from other programs has never been easier.

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- keystroke compatibility with Z88 & PC PipeDream
- Z88 filing system
- automatic loading of VIEW, ViewSheet, Lotus, First Word Plus, Tab and CSV files
- automatic saving of VIEW, Lotus, Acorn DTP format, Tab and CSV files
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BBC ACORN USER

APRIL 1990 ISSUE NO 93

58
BRAIN DRAIN



Cover illustration by Gary Embury

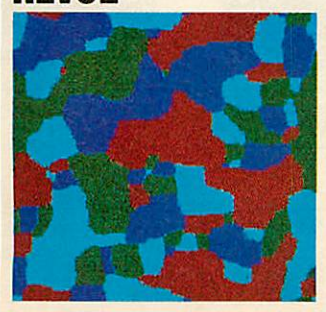
120
A PIECE OF THE ACTION



64
TALKING TERMS



30
RISC REVUE











U.I.M.

U.I.M. is a massive 3D arcade adventure set in the future. 2½ years of dedicated design and programming have produced this massive game.The "greenhouse" gases melted the icecaps and all life now exists in the oceans. There are over 65000 underwater ports each with their own colonies.

You must travel the oceans, trading in commodities, shares and currency. There are over 250 missions to complete before you will find your goal - the U.I.M. - created to be almost a god! Your craft is a highly manoeuvrable (and expandable) futuristic submarine named Black Satyr.

On your travels you will encounter many submarine types. Many of the most advanced and aggressive submarines do not appear until you reach later networks of ports. In addition you will also meet the Replicants - man-made underwater machines which have gone "renegade" and are capable of reproduction.

As you progress it is therefore essential to avail yourself of the highly sophisticated range of combat and defensive equipment available. The quest for the U.I.M. will be long and involved, the dangers intense, but the reward priceless!

"Will I keep playing it the way I've played Elite for years? And the answer is YES. Graphics 10, Playability 10, Value for Money 10"........................*The Micro User, Nov' 89.*

U.I.M. is disc only and will run on BBC B or B+ with 16K of sideways RAM, BBC Master series and all Archimedes Computers.

BBC

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E-TYPE

Take control of £70,000's worth of gleeming "E-Type" and head off for the drive of a lifetime. Hear the digitised roar of the 5.3 litre 12 cylinder engine as you tear along lanes, motorways and desert tracks at over 150 mph.

"E-Type" takes racing simulations into the world of 32 - bit RISC processing and gives you smoother, faster and more detailed graphics than you are even likely to see in the arcades.

E-TYPE

"On the Archimedes the illusion of speed is terrifyingly real and the way the landscape moves in three-dimensional perspective is a joy - a stunning experience"..........*The Independent, Dec' 89*

"This is a superb game....the tracks are fantastic"........*The Times, Dec' 89*

"No race game, on any other machine, looks as good"...........*The Times Educational Supplement, Dec' 89*

"For challenging races with a real sense of speed and fun, go for E-Type's ignition key"............*The Games Machine, Feb' 90*

"There's just one word to describe E-Type: FANTASTIC! Graphics 10, Value for Money 10"............ *The Micro - User, Dec' 89*

"The graphics in E-Type are really superb. E-Type in my opinion is probably the best game yet for the Arc".... *Risc User, Dec' 89*

E-TYPE DESIGNER & EXTRA 100 MILES

Design your own "E-Type" tracks with this highly advanced but simple to use designer. It is enormously flexible to produce an endless variety of tracks to challenge you and your friends.

"The perfect complement to E-Type"... *The Games Machine, Feb'90*

There is also an extra tracks disc featuring extra sprites and 100 miles of cunningly designed roads.

Please note that you will need the original E-Type game to use either the Designer or the Extra Tracks discs.



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WHITE MAGIC

White Magic is a unique arcade adventure in which you control 4 varied adventures:-

Kaldor the Leprechaun, Cheysul the Titan, Moriana The Warrior and Mandrake the Enchanter.

You can transform between all 4 characters at will and use their much needed special abilities.

It features 32 massive action-packed levels filled with aggressive guards and trolls, haunting ghosts and spectres, curious objects to find and use, and much more .....

White Magic is not a game for the faint-hearted; it is a fast-action game which requires fierce hand - to - hand combat and frantic weapon fire.



BBC



ARCHIMEDES

APOCALYPSE

Produced by Gordon Key, the author of Holed Out and E-Type, this incredible new game sets new standards of excellence in 3-dimensional solid graphics and digitised sound effects. Your overall task is to rescue a whole solar system from an evil dictatorship. Apocalypse is a feast for your eyes, ears and grey matter.

Release date: 5th March, 1990.

See your dealer or ring for your copy today

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Nevryon	-	14.95	-	15.95
U.I.M.	29.95	19.95	-	21.95
The Olympics (6 Events)	19.95	-	-	-
E-Type	19.95	14.95*	9.95*	15.95*
E-Type Designer	16.95	-	-	-
E-Type Extra 100 Miles	16.95	-	-	-
White Magic	19.95	12.95	9.95	13.95
White Magic 2	19.95	12.95	9.95	13.95
Arcade Soccer	19.95	12.95	9.95	13.95
Holed Out	19.95	14.95	12.95	15.95
Holed Out Extra Courses 1	16.95	11.95	9.95	12.95
Holed Out Extra Courses 2	16.95	11.95	9.95	12.95
Holed Out Designer	19.95	-	-	-

* E-Type BBC & Electron versions due for release 7th May, 1990. All the above Archimedes games will work on the Archimedes A3000, 310 and 400 series

DIMENSION





WHITE MAGIC 2

his includes 32 brand new and ighly dangerous levels plus a omplete level designer.

he level designer is a doddle to se and can be used to alter or esign levels from scratch.

n extra invisible feature in White lagic 2 will really confuse our dventurers!

eviews of White Magic

The graphics are superb .... n absolute winner" *lectron User Golden Game ugust '89.*

Playability is good and I had to ear myself away in order to write his update review." *rchie review - The Micro User, ctober 1989.*



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HOLED OUT

The most comprehensive, realistic and highly acclaimed golf simulation on the market today. This volume contains the original 2 contrasting 18 hole courses and comes complete with an easy to follow 16 page manual.

"I play golf and this game is the closest thing I've seen to the real game on a computer". *Archive, June 1989*
"I wouldn't have thought it possible to get a better simulation out of the beeb".
BBC Acorn User, June 1989

"The 3D perspective graphics are stunning"............***Electron User GOLDEN GAME June 1989***

"Holed Out is great ..... The game plays very well and the graphics are superb"...............
Popular Computing Weekly. March 1989

"The Electron version is brilliant - it's almost the same as playing at Gleneagles. Unreservedly recommended"................. ***A & B Computing Game of the Month, June 1989***

HOLED OUT EXTRA COURSES

In response to your many requests we have now produced 2 volumes of extra courses. Each volume contains 2 superbly designed brand new courses. Each course has been meticulously created to test your golfing abilities to the limits. The holes are very varied and even Nick Faldo would need to use his skills to keep up his recent record.

ARCHIMEDES HOLE DESIGNER

Create your own golf courses with this easy - to - use yet highly sophisticated hole designer. Its flexibility allows you to define all aspects of the holes from their pars to the position and size of the lakes. It will keep you enthralled for years.

"The Holed Out Designer is very easy to use and it makes a perfect complement to the original game"........
The Micro - User, Jan' 90



BBC



ELECTRON



ARCHIMEDES



ARCHIMEDES

ARCADE SOCCER

Arcade Soccer really is football action at its very best.

Using an overhead view to make game play as exciting as possible it features everything that you could want in a football game. Corners, sliding tackles, throw-ins, goal kicks, dribbling, shooting, passing and much more. But not only does Arcade Soccer give you Total Action it also puts you in Total Control.

Firstly you can play with either keyboard or joysticks, against the computer and/or with up to 23 friends. The options are almost limitless; you can choose the skill of the goalkeepers, the speed and length of the game, play "friendlies" or tournaments and even enter the most coveted of championships - the World Cup.

"The game is very playable and you do get a feeling of involvement as you knock the ball into the corner of the net straight past the diving goalie. It's definitely one to play again, and if you've enough friends it could make for a good day of enjoyment - and not a lot of games can do that. Value for money ... 10 out of 10"......
The Micro User, October "89.

"This game is excellent ... I'm not a real soccer buff, but I thoroughly enjoyed this desktop version. The micro-controlled players behave in an amazingly realistic manner. Playability 10." ... ***Archimedes review, The Micro user, Feb' 90***



ARCHIMEDES



BBC



ARCHIMEDES



ARCHIMEDES

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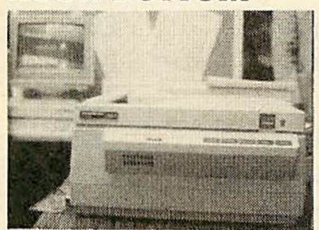
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The Fourth Dimension, P.O. Box 4444, Sheffield, S3 8NN.



The Fourth Dimension

LASER HIT ROCK BOTTOM



Innovative use of the Archimedes has enabled Rand Services to offer a laser printer for less than any other comparable machine.

The Rand laser printer uses an Arc podule to directly drive the latest Mannesmann tally print engine, using the computer's memory and processing power. This saves any 'intelligence' in the printer itself. The Rand printer costs just £1135 and will operate on any Arc with 3Mb or more memory.

The Rand printer package includes desktop software to use the printer in the same as conventional Risc OS printer drivers. This means the printer works just like a Postscript laser printer.

The MT906 print engine used is one of the most economical to run and is used at its full speed – about 7PPM.

Further details from Rand Services on (0223) 461300.

CD-ROM FOR ARCS

CD-Rom optical data storage has come to the Acorn world with a joint venture between Acorn and Next Technology.

The CD-Rom system developed by Next uses a standard Hitachi stand-alone drive on an Archimedes or A3000 with a SCSI interface.

A CDFS filing system is supplied to access discs. This can read Ascii data on existing CD-Roms conforming to the 'High Sierra' format and intended for the PC market, but it doesn't have the advantage of the MS-Dos extensions for searching data and presenting pictures.



A 12cm CD-Rom disc can hold about 550Mb of data. This is enough memory for 250,000 pages of text.

Next Technology sees the package as 'a resource' for other parties to develop a base of CD-Rom data especially for the Acorn market.

The company claims to be able to produce a single CD-Rom disc for less than £300 – a breakthrough price which will enable schools to produce their own resource material and will allow companies to cheaply archive data.

Already the Neris on-line educational database is lined up for regular distribution on CD-Rom to schools without comms facilities.

The Next CD-Rom package will also play audio CDs (under computer control) and will cost about £600 complete with CDFS and a 'clip-art' disc. Further details from Next Technology on (0223) 420222.

● Acorn is celebrating the launch of the CD-Rom system for the Archimedes with a competition for schools to think up an innovative idea for a CD-Rom application.

Entries of no more than 500 words and based on a National Curriculum subject should be sent to Katherine Pierpoint at Acorn, Fulbourn Road, Cambridge CB1 4JN by the 27th April.

The winning school will receive an A3000 and CD-Rom system along with its project material on a CD-Rom.

THREE DOWN

Aleph One's Arm3 upgrade for the Arc is down in price, to £495 for the 20MHz version reviewed in the February *BAU*.

A 30MHz upgrade offering even better speed increases for the Arc will be available soon for £595 and 20-30MHz upgrades are planned. Aleph One is on (0223) 811679

HYPERMEDIA FIRST CHAPTER

Genesis brings the popular *Hypercard* type software concept to school children using the Archimedes and A3000.

The program is an information organising retrieval and display package produced by Software Solutions in conjunction with Hampshire LEA.

Working fully with Risc OS, *Genesis* is a database of interlinked pages containing text, pictures, animated sequences or music. Pupils can individually work on single pages which are then grouped and linked to form a complete class project or resource.



Genesis operates on any Archimedes or A3000 with 1Mb or more of memory and costs £80. Econet site licences are available.

Further details may be obtained from Software Solutions on (0954) 211 760.



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Published by Redwood Publishing, 20-26 Brunswick Place, London N1 6DJ. Tel: 01-490 1444. Telecom Gold 81: RED001, Micronet 919992492. Printed by Riverside Press, Gillingham. Typeset by C B Origination, 182 Pentonville Road, London N1 9LB. Colour by Trumps Studio, Ware, Herts. Distributed by BBC Magazines, 35 Marylebone High Street, London W1. ISSN 0263 7456.

MUSIC LESSONS

Hot on the heels of the Music 5000 Universal from Hybrid Technology come two *Sound World* software packages for young education users.

Soundspace costs £33.35 and turns the Beeb into a flexible and unusual musical instrument. A joystick or touch screen controls pitch and sound texture and the package is aimed at special needs users.

Soundscape (also £33.35) uses the Music 4000 keyboard alone to compose and perform music. The white keys are used to play the music while the black keys select sounds.

Further details from Hybrid on (0223) 420360.

● EMR's Arc/A3000 software, *Microstudio* teaches pieces of music in the same way as expensive computer controlled pianos. Music is entered from a MIDI keyboard or imported from *Studio 24 Plus* and the pupil 'plays along' with the program which will display what's happening, play the music and detect mistakes.

Examination material for piano grades 1-5 is available. Micro studio costs £79.90 from EMR on (0702) 335747.

DAB HELP

Dabs Press can provide a hand for new and more experienced users alike. For the beginners is *Archimedes First Steps,* a book for newcomers to the machine. Written by Anne Rooney, it covers Risc OS, DTP and choosing software.

Also new from Dabs is the ArcDFS filing system. Priced at £29.95 and working from the icon bar, this transfers files from the BBC micro to the Arc.

Dabs' Cambridge Pascal is an enhanced version of the Pascal language with DTP and Basic extensions.

It costs £79.95 and a free demonstration disc is available on request.

Further details from Dabs Press on 061-766 8423.

MICROVITEC BACK TO THE FOLD



Leading monitor manufacturer, Microvitec, has given the BBC A3000 a vote of confidence with the Cub3000 monitor especially designed for the latest Acorn micro.

The Cub3000 is a medium resolution 14in colour monitor produced as a sequel to the highly successful Cub monitor currently supplied to model B and Master owners.

With just the analogue RGB input and finished in Acorn A3000 colours, the Cub3000 will retail at less than £140+VAT as competition for the AKF11 monitor supplied by Acorn. Further details from Microvitec on (0274) 39011.

KEY TO THE ARC



Anglia Television is to release an enhanced version of the ITV *Key* data handling package for the Archimedes this Easter.

Written for Anglia by educational software house GSN, *Key Plus* has been developed for ITV Schools as an advanced version of the *Key* system, which forms the basis of a cross-curriculur information system that runs on BBC model B and Nimbus micros.

The enhanced version for the Archimedes, IBM PC and compatibles retains the characteristics of the existing database system including the ability to access existing *Key* datafiles.

The new version also incorporates mouse control and windowing with interactive video disc control. A range of graph and statistical facilities, together with map and graphic handling in colour is also included.

Available for the Archimedes later this year will be *Key Author,* a knowledge based system which will be followed by *Key Calc,* a spreadsheet which will integrate with *Key Plus.*

Key Plus costs £50. Anglia is on (0603) 615151.

CALLING ALL ARC ARTISTS



Video production company Hardwire is looking for graphics from Arc users for a Channel Four TV programme.

Hardwire (whose *Coldcut* pop video was featured in the February issue) has been asked by Channel Four to contribute to a short programme featuring a collection of artistic images to be screened in the summer.

The programme will include a compilation of the public's impressive images created on computer and that's where *BAU* readers could fit in.

'We're not looking for something created by a technical genuis,' said Hardwire's Robert Pepperwell.

'What we want is fascinating images which viewers will find interesting'.

All contributors will be credited at the end of the programme and nothing will be used without your permission. If you'd like to contribute, send your work on a 3.5in Arc compatible disc to Hardwire, 5 Cumbria Road, London SE5.

FREE EXTRAS

Watford Electronics is giving away a free Realtime Video Digitiser with every Arc 310 sold before the end of March.

Alternatively, anyone buying an Arc 440/1 during this period will receive a free Taxan 770 Plus multisync monitor.

Watford Electronics is on (0923) 37774.

NEWS IN BRIEF

● A five part ITV Schools television series involving the use of computers for cross-curriculum work by nine-13-year-olds is currently being screened on Channel 4 and S4C, the Welsh fourth channel. *The Micro Class* is screened on the schools service over the spring term each Wednesday at 11.41am.

● Details of BBC Schools programmes on the television and radio are now available on Acorn's Support Information Database (SID). The viewdata compatible service is accessible via Prestel or Fastrack.

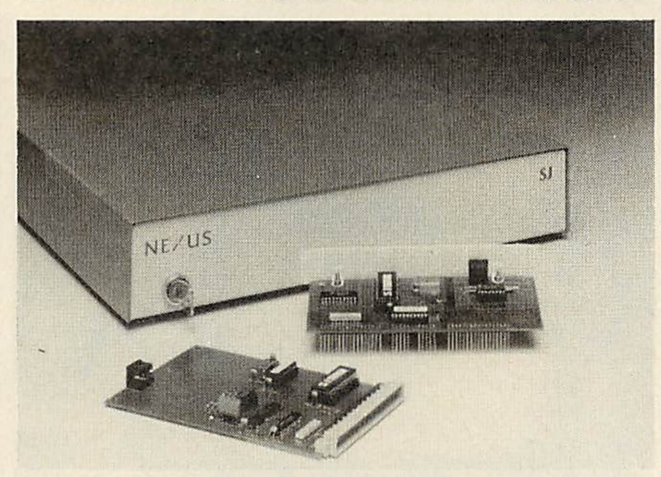
● Electromusic Research has launched version 2 of *Studio 24 Plus*. The new program can include EMR's numerous other music software and adds extras such as realtime music notation, SMPTE time codes and what EMR claims is a video film production suite built-in! EMR is on (0702) 335747.

● Also from EMR is a dot-matrix version of the *Scorewriter* PMS music notation printing software. The program is upgradable to the original Postscript version and uses the same files. It costs £149.

● Saturn Software has produced an updated version of its 1770 DFS. VO. 72 incorporates three additional OS calls, a new utility command and can read/write and format a 40 track disc in an 80 track drive. Saturn is also developing an 8271 DFS. An information sheet is available from 59 Redesmere Drive, Alderley, Edge, Cheshire SK9 7UR.

● The postcode given last month for Swallow Systems, makers of educational floor robot, Pip, was incorrect. The full address is 32 High Street, High Wycombe, Bucks HP11 2AQ.

SHARE A HARD DISC



Econet specialists SJ Research has developed Nexus, a central hard disc server for Archimedes computers.

Nexus allows four Archimedes to share a 40Mb hard disc. Applications can be stored on a common directory with file locking. Each can be assigned its own disc partition and security is provided with a keyswitch to select read only or read-write.

Each workstation has a podule, cable and Rom software. Nexus icons appear on the desktop like two local hard discs and to applications, Nexus discs are indistinguishable from local discs.

The hard disc controller uses an Inmos Transputer chip, chosen for its high-speed communication between workstation and disc. This will enable Nexus to be used with other makes of micro and allow communication between them and with other networks such as Econet and Ethernet.

Prices for the system start at £1240 for a 40Mb disc and controller and £59 per interface for the A3000, and £69 per interface for other Arcs. SJ Research is on (0223) 461426.

INTO THE NINETIES WITH BAU

The first *BBC Acorn User* Show of the nineties will take place at the Westminster Exhibition Centre on 7-9th September.

As well as a vast range of Acorn machines, software and peripherals on display, there will be seminars covering machines ranging from the Electron to the A3000 and super competitions for terrific prizes!

Access to the show is easy with underground and mainline trains just a short walk away.

Tickets will be on-sale soon and to ensure you don't miss out, it's best to reserve yours early. Contact the show organisers, Safesell, on (0737) 814084 or 814085.

● Meanwhile Cambridge International Software is hosting an Archimedes Spring Fair at its London headquarters on 10-11th March.

A range of Archimedes software, including special needs, will be displayed.

Familiar names such as Minerva, Dabhand and Computer Concepts have all confirmed their stand space and *BBC Acorn User* staff will be on-hand to answer queries. For further details, contact CIS on 01-833 4023.

ATELIER ON TV

Atelier, voted the best 32-bit art package in the *BAU* 1989/90 Awards is currently being used by the BBC for the new *Science Challenge* programme. The Arc based package is being used to produce graphics for the new series which is the BBC's response to the National Science Curriculum.

The programme aims to bring science to life and features children who create stories using a computer.

Besides being used for title-sequences, *Atelier* is used throughout the programme to draw an island and illustrate stories. The sequencer supplied with the package is also used to animate these pictures.

Atelier costs £100 and is available from Minerva Software on (0392) 437756.

CHEQUE IT OUT

Cheque, the *Wordwise Plus* cheque management package, reviewed in the March issue, costs £25 from Carious Software, 54 Moor Crescent, Gosforth, Newcastle upon Tyne NE3 4AQ. Tel: 091-285 0097.

DIARY DATES

10-11 March. Archimedes Spring Fair, Cambridge International Software, Herbrand Street, London. CIS on 01-833 4023.

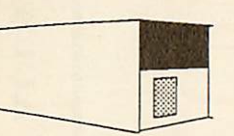
13-14 March. International Software Awareness Exhibition, Queen Elizabeth Hall, Civic Centre, Oldham. Contact LTS on (0386) 793147.

15-18 March. Computer Cash & Carry 90, G-Mex Centre, Manchester. Contact EMAP on 01-404 4844.

26-27 March. International Software Awareness Exhibition, North Avon Teachers' Centre, Winterbourne, Bristol. Contact LTS on (0386) 793147.

24-27 April. Which Computer? Show. NEC, Birmingham. Contact Reed on 01-948 9800.

16 bit SCSI



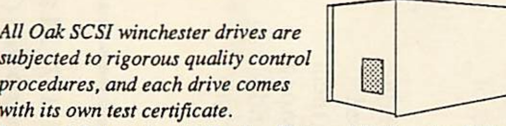
Oak's high speed 16 bit SCSI podule offers a new level of performance for the entire Archimedes range (including the A3000) with data transfer rates of up to 1.4Mb per second, a considerable increase over both ST506 and 8 bit SCSI controllers. Up to 2 Gigabytes of winchester storage may be fitted per machine, and seven SCSI devices including 4 winchesters may be attached to the card.

The card provides a new filing system 'SCSIFS', and an icon and filer for the Risc OS desktop. It can work in tandem with ADFS winchesters, and is compatible with the PC emulator. Low level (SWI) support is provided for other SCSI devices (e.g. tape streamers, CD ROMS etc.)



Internal winchester kits are supplied as 'plug in and go' units, with all necessary cabling and mounting hardware, and external drives are supplied in sturdy metal cases, colour matched to the Archimedes, and have their own power supply and fan. External drives are also suitable for the A3000.

A comprehensive manual with easy to follow fitting instructions is provided with each system, along with a versatile formatting and utility program. Oak SCSI drives may be write protected for security.

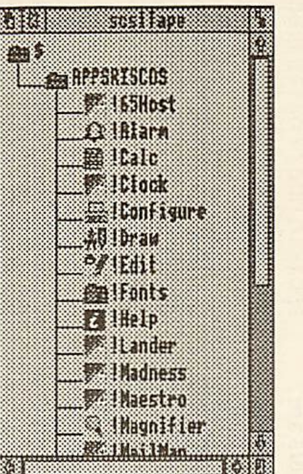


All Oak SCSI winchester drives are subjected to rigorous quality control procedures, and each drive comes with its own test certificate.

Internal Drives *(inc. SCSI card)*		**External Drives** *(inc. SCSI card)*	
20Mb (HDINARC20SC)	*£375.00*	*20Mb (HDEXARC20SC)*	*£535.00*
45Mb (HDINARC45SC)	*£495.00*	*45Mb (HDEXARC45SC)*	*£655.00*
70Mb (HDINARC70SC)	*£895.00*	*70Mb (HDEXARC70SC)*	*£1055.00*
100Mb (HDINARC100SC)	*£1274.00*	*90Mb (HDEXARC90SC)*	*£1249.00*
200Mb (HDINARC200SC)	*£1666.00*	*135Mb (HDEXARC135SC)*	*£1625.00*
SCSI Card (SCSIARC)	*£199.00*	*170Mb (HDEXARC170SC)*	*£1850.00*
SCSI Card (SCSI3000)	*£199.00*	*330Mb (HDEXARC330SC)*	*£2845.00*
P&P internal drives/card	*£10.00*	*P&P external drives*	*£15.00*

16 bit SCSI Controller Card and High Speed Winchester Drives

Tape Backup



Oak SCSI tape streamers, available in 60Mb and 150Mb capacities are the ideal means of backing up large amounts of data. Using 'DC600' type data cartridges and high quality tape drive units, Oak tape streamers provide a reliable insurance against data loss.

Multi-tasking, window software allows information to be backed up from any Archimedes filing system.

Restoring data from tape is simple. A tree viewer of the directory structure stored on the tape, or a 'filer' type display can be shown in a window, and then the files to be restored can be simply 'dragged' with the mouse to the destination filing system, or even into an application!

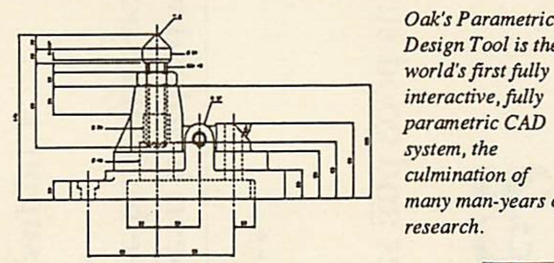
Unattended backups may be triggered on a regular basis using the inbuilt automatic backup facility. Prompts to prevent accidental overwriting of existing files may be given during a restore as required.

Note: An Oak SCSI controller card is required.

Tape Streamers	
60Mb without SCSI card (TS60SCA)	*£999.95*
60 Mb with SCSI card (TS60SC)	*£1099.95*
150Mb without SCSI card (TS150SCA)	*£1254.00*
150Mb with SCSI card (TS150SC)	*£1354.00*
P&P on Tape Streamers	*£15.00*
60Mb Tape Cartridge	*£24.95*
150Mb Tape Cartridge	*£27.95*
P&P on Tape Cartridges	*£0.75*

SCSI Tape Streamer

2D Design



Oak's Parametric Design Tool is the world's first fully interactive, fully parametric CAD system, the culmination of many man-years of research.

PDT stores the relationships within a design rather than absolute co-ordinate values, and so when a design is modified, all the repercussions of the change are executed automatically by PDT.

Designs may be animated and subjected to 'what if' tests. Families of parts obeying common design rules may be generated quickly from one master model.

PDT also has powerful uses outside the area of Computer Aided Design. PDT can be used as a modelling tool, by allowing the user access to its powerful maths 'engine'. For example, a drawing of a spring could be created where the length of the spring is related to its load by Hookes Law. By changing the load on the spring, its new length will be calculated by PDT and may be displayed pictorially, in graph form and numerically on screen.

PDT outputs to HPGL compatible plotters, or via Risc OS to a wide range of printers. Drawings from PDT may be exported to art packages for colour rendering, graphics packages such as !Draw, and then on to DTP etc.

£359.00 (£5.00 P&P)

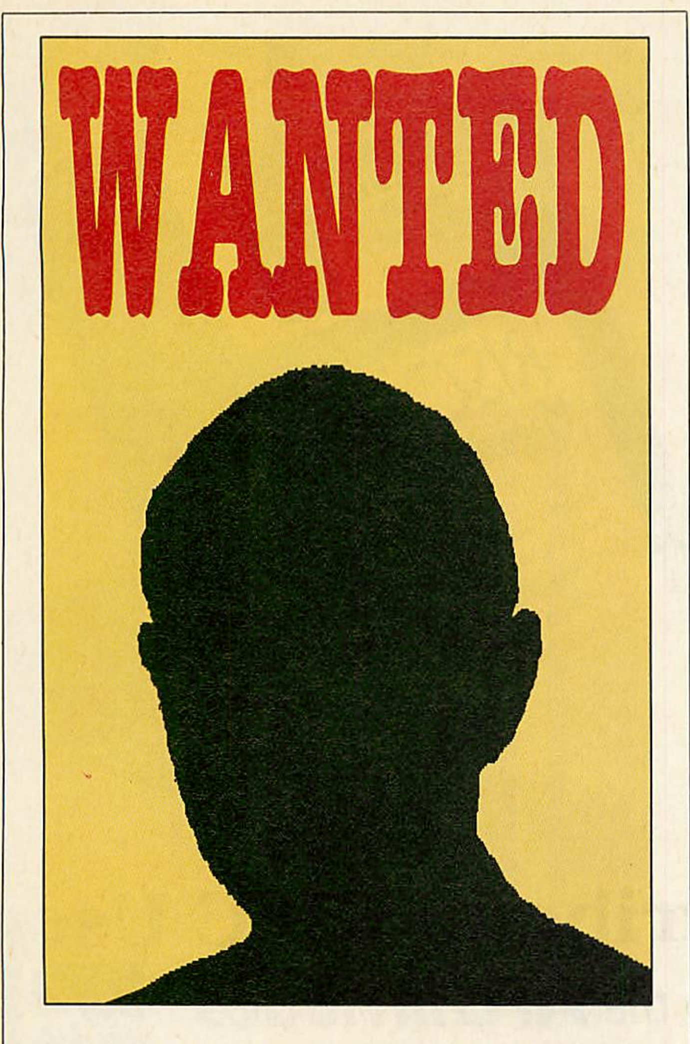
PDT
Parametric Design Tool



Oak Computers
Cross Park House
Low Green
Rawdon
Leeds
LS19 6HA
Tel: 0532 502615
Fax: 0532 506868

Government Orders Accepted

All prices exclude VAT.



TECHNICAL ASSISTANT

for BBC Acorn User

BBC Acorn User magazine is looking for a Technical Assistant to help with the production of this, the biggest, best selling magazine for users of Acorn Computers.

You should have a good working knowledge of Acorn computers (either 8-bit or 32-bit, but preferably both) and some experience in programming. Some writing ability would also be desirable but most important is relentless enthusiasm and a willingness to apply yourself to the wide range of duties the position involves.

The Technical Assistant will be responsible for some feature and review writing, editing the yellow pages, answering readers' technical enquiries, providing technical help for the rest of the editorial staff, helping to judge readers' contributions and all kinds of other bits and bobs not yet even dreamt of.

The *BBC Acorn User* editorial staff are a tightly knit bunch of people, wonderful to work with, the likes of which cannot be found anywhere else.

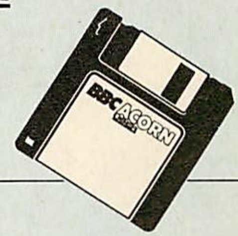
Salary will be according to age and experience.

Please apply with a full curriculum vitae and any examples of your programs or published work to:

The Editor
BBC Acorn User
Redwood Publishing 20-26
Brunswick Place
London N1 6DJ

Mark your envelope 'Technical Assistant'.





A NOTICE TO OUR JOINT MAGAZINE AND MONTHLY DISC SUBSCRIBERS

Because of the incredible response to the special subscription offers in the January and February issues of *BBC Acorn User*, we have been inundated with orders.

They are being processed as fast as possible, but while your subscription details are being set up on our computer you will receive your monthly disc by separate post, a few days later than your magazine.

As soon as all the new subscriptions have been logged this service will return to normal.

We welcome all our new subscribers and ask you to bear with us until the orders are processed.





BETTER THAN EVER

The sixth annual British Education and Training Technology (BETT) exhibition at London's Barbican in January was the biggest ever, with over 150 stands.

The exhibition was opened by new schools minister Alan Howarth, who was half an hour late for the opening ceremony.

Mr Howarth surprised the reception committee by entering by the back door, having bluffed his way past officious security guards. He blamed his chauffeur and the maze-like Barbican for his tardiness. The latter excuse certainly rang true.

Almost 10,000 teachers and advisers passed through the portals of the Red and Blue Halls over the four days.

Many clearly couldn't get cover for a week-day visit as attendance was particularly strong on the Saturday.

Phalanxes of parents were also to be seen earnestly enquiring about which computer they should buy for a super-bright five-year-old and how could they find the exit.

Among the show's special features, the seminar programme, which illuminated topics as diverse and hot as National Curriculum attainment targets, local management of schools and in-service training, proved very popular.

There was a great deal of interest in the Educational Technology Awards, particularly the gold winner in the secondary category.

Spacetech itself did not exhibit but demonstrated its weather satellite podule for the Archimedes on the *Educational Computing and Technology* stand.

Here it attracted a lot of attention, not just from teachers but from the Royal Navy and the satellite company BSB which is now considering using the system for its televised weather reports.

Acorn, of course, had its usual extensive stand with space given over to software companies and regular demonstrations every half hour.



Education minister Alan Howarth (second from right) maintains his interest as students on the West Hatch/Pimlico/Boynton stand demonstrate their project work. However, members of his entourage look as though their minds are elsewhere – probably on how they're going to find their way out of the Barbican

While Acorn still dominates the education market, other hardware manufacturers are definitely making a firm impression.

Apple and Research Machines had stands large enough to rival Acorn and both received a lot of interest.

However, a group of three schools proved that the best way to attract show-goers is to have real schoolboys and girls working on your stand.

West Hatch High School in Chigwell, Essex, Pimlico School in London and Boynton School in Cleveland are collaborating on a cross-country, long distance learning project.

Using equipment from a variety of manufacturers, including Acorn, they were at BETT to demonstrate how far they've got with exchanging project information between schools by downloading onto electronic mail.

Many companies immediately re-booked their stands for BETT '91, proving that, from their point of view, the show had been a success. This sentiment was echoed by many visitors who said yes, they would be back for BETT next year.

HANDS-ON HISTORY

Castles is the theme of an exciting new cross-curricular, project-based competition.

Students are required to build a scale model of a real castle using Data Design's *Designer Castles* software and clues on its construction and location sent out via Campus 2000's electronic mail service.

The clues will be transmitted daily throughout a four-week period, beginning in April.

All participants will receive 'curriculum packs' containing background information on how castles were built and how life was lived back in medieval times.

There will be prizes for the best model castles in a number of categories and also for the best pupils' project packs on castles received.

To find out more about the competition contact Averil Silver at Campus 2000, PO Box 7, 214 Grays Inn Road, London WC1X 8EZ.

Lisa Hughes

NEWS IN BRIEF

● Look out for an Arc package called *Tabs*, from Tap Consortium.

On show at BETT and scheduled for release in May this year, *Tabs* is a 3D design tool which operates on a similar principle to *Designer Castles*.

However, with *Tabs* you're not restricted to castles or medieval villages, you can design anything.

The user has a 2D edit window and a 3D perspective view, both of which are continuously updated.

When a printout is required, the software 'unfolds' the design and puts in tabs in the right places. A scale model can thus be assembled.

Tabs has a lot of educational potential and looks like it's fun to use. Taps Consortium is at 34 Drake Gardens, Tavistock, Devon PL19 9AT.

●*Primary Healthdata* is a new health education package for nine to 12-year-olds, based on the well-established on-line database run by Dr Christopher Dobbing.

The discs contain 400 pages of health information presented in a simple menu-driven structure.

More information from Healthdata, 21 Vicars Close, London E9 7HT.

●The National Environmental Database is an interactive database on Campus 2000. National data has been supplied by groups such as the RSPB. However, most of the information has been collected by schools during ordinary lessons.

Schools enter data into *Key*, the NED software encodes the datafiles and they are then sent up to the Campus 2000 computer.

More details from the NED Project, King's College London, 552 King's Road, London SW10 0UA.



STORMY WEATHER

One day, while browsing through the January edition of *Byte* magazine, I happened to come across the editorial. Written by the Editor in Chief, Fred Langa, he detailed how hard it was for people to communicate with each other in the aftermath of the California earthquake of winter 1989.

Briefly, the problem was not that the telephone system was damaged but that it was bogged down with traffic due to people trying to get in contact with each other. This was the case for a few days after the quake.

A couple of enterprising people in the quake zone used their laptop computers to access their local packet through which they managed to log-on to BIX, an information exchange system.

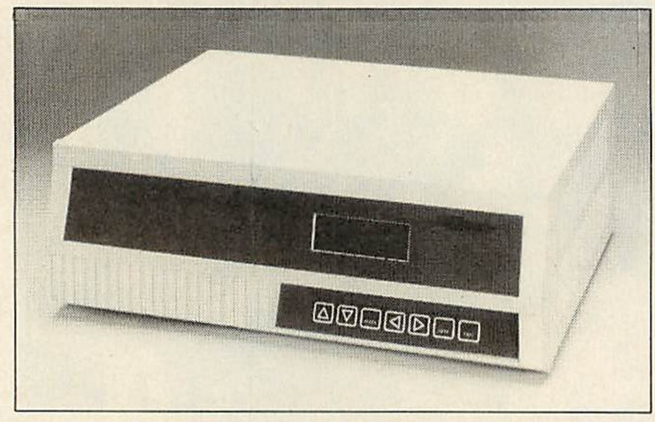
Doing so they collated and conveyed messages to and from loved ones, and in all, a valuable humane service was provided. *Project Notify* was born out of that disaster, and it aims to keep people informed during disasters – be they man made or otherwise.

Good idea, I thought, but we don't need that here. The following day (25 January) gale force winds swept through the UK leaving over 40 dead and many injured.

Personally, it was a harrowing time for my family and myself in London as for eight hours we could not get through to relatives in Hastings, Kent. Yet the Hastings exchange was operational. The problem was that, like myself, others were clogging up the ciruits to and from London.

The voice circuits that is, because dedicated lines used for digital communications were relatively free (and operational). Now, the UK has vast digital networks.

There's the obvious one used by Prestel, which provides coverage for over 90 percent of the population. Then there is PSS (Packet Switched Stream), which in turn is linked to its international counterparts.



As previously reported on this page, the government is considering licensing modems. The idea being that a register of modem users would facilitate the tracing and conviction of hackers. The 0401 Plus point-to-point Lirpa-1 multiplexer pictured above, will, when connected to a System-X/Y or Strowger exchange, sample up to 2048 calls simultaneously and detect which lines are being used for data. Should modems be licensed this unit will be used to detect modem users who have not registered their equipment.

IN PRACTICE

With the co-operation of commercial on-line services such as Prestel/Micronet and Telecom Gold, *Project Notify* could work here in the UK. It would be possible for people in disaster areas to collate short messages from residents in the community, together with a recipients's telephone number.

The individual would then be able to access the on-line service and 'post' the messages on a conference area or Chatline equivalent.

The messages would be read by other subscribers throughout the country, and if a message were addressed to someone local it could be relayed by voice or in person.

What at first seemed to me to be a good idea is actually an excellent one. Providing supplementary channels of communication for private citizens during a disaster.

If, like me, many of you were trying to get in contact with someone during the gale to see if they were OK then you'll appreciate just how valuable a service it could be.

I say 'could' because what's needed to get the ball rolling is some real commitment from the commercial on-line services such as Prestel and Telecom Gold.

They would be used as the collecting area for all incoming messages from different parts of the country. Telecom Gold and Prestel which are both run by Dialcom have extensive messaging facilities.

Both have public areas where messages can be read by one and all.

Such an area could be set up during an emergency, and I'm sure many subscribers would be more than willing to send and relay messages.

So how about it Dialcom? Anyone wishing to discuss the idea further may use this column as a platform in which to do so.

David Janda

NEWS IN BRIEF

Alas the whole business surrounding the Law Commission's report on hacking has not died down. Even though the hacking Bill was dropped from the Queen's speech, another Tory MP has decided to ride the glory train, which is also known as the Private Members Bill.

This time it's the turn of Michael Colvin, MP for Romsey and Waterside. Colvin's Bill proposes tougher sentences than those recommended by the Law Commission's report, and Colvin is confident that his Bill will be passed during this session of Parliament.

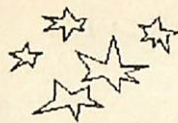
The Bill proposes that hackers should be jailed for up to six months. It also deals with the UK hacker who hacks systems abroad.

● The time is near when 01 for London will be no more. This will be changed from 01 to 071 and 081. London based BB operators should advertise their new prefix well in advance of the changeover. Those of you who use auto-dialling software should also be prepared to amend your London numbers.

● Remember Keith John Rose, the former boss of the now defunct Modem House? Rose was arrested last year for kidnapping Victor Cracknell for a one million pound ransom.

Rose has now been commited for trial at the Old Bailey. He has also been accused of kidnapping Cracknell's wife and breaking and entering while armed with a shotgun!

If you have any comms news please send it to David Janda at BBC Acorn User or contact him on Telecom Gold 81: RED001 or via Prestel 919992492.





AND Mercury Games

Archimedes CHECKLIST Archimedes

TITLE	RRP	SALE
3D Pool . . . 'phone for release		
1st Word Plus	91.94	£84.95
Acheton	19.95	£17.95
Alerion	14.95	£11.95
All in Boxing	14.95	£11.95
ALPS SYSTEM . . *NEW*	32.00	£27.95
Alpha Base	49.95	£44.95
Ancestry	79.95	£69.95
Ansi C (Release 3)	171.35	£154.95
ARC-COMM	29.95	£26.95
ARC-PCB	195.00	£175.95
Arcade 3 Compilation (Zarkon Invasion, Mazey Man & Bounce-a-Ball)	14.95	£11.95
Arcendium (Back Gammon, Draughts, Othello, & Connect Four)	14.95	£11.95
Arch. Reference Manual	29.95	–
Arch Operating System	21.95	–
Arch Assembly Lang.	21.95	£18.95
Arch. Basic Compiler	99.95	£89.95
Arcane Lore . . . 'phone for release		
Arctrivia	24.95	£19.95
Armadeus	79.95	£69.95
Armadeus Sound-Samp. Board	149.95	£139.95
ARTISAN 2	59.95	£54.95
Assembler	228.85	£199.95
Atelier	99.95	£89.95
Avon	19.95	£17.95
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QUESTIONS AND ANSWERS

Q The hard disc I have attached to my BBC Master 128 came without a program for backing up. I think I ought to back up the data I have stored before something tragic happens! Can you recommend a suitable program?

A You certainly must back up your valuable data and programs you have stored on your hard disc and you should do this regularly. The ADU Rom comes from Pineapple Software, 39 Brownlea Gardens, Seven Kings, Ilford IG3 9NL, tel: 01-599 1476. This is a package of ADFS utilities containing a *BACKUP that will copy the contents of your hard disc on to ADFS floppies.

Q My daughter has a Siel MK900 MIDI keyboard which she wants to use together with my BBC Master 128 computer. Is this possible?

A Since your daughter's keyboard is a MIDI instrument, you should be able to connect the keyboard to a computer with a MIDI interface.

A number of MIDI interfaces are available for the BBC Master and they are usually supplied with some sequencing software.

Two possibilities you might like to consider are the UMI-4M from U-music, 17 Parkfields, London SW15 6NH, tel: 01-788 3729 or the Miditrack system from EMR, 14 Mount Close, Wickford SS11 8HG, tel: (0702) 335747.

Q I am the co-editor of a medical text book, and unfortunately the colleague I work with uses an IBM PC compatible for writing and editing, while I have an Archimedes A310.

I don't want to use the PC emulator or even purchase an 'out of date PC clone' so we can be compatible and have the same machinery for the work. My friend won't move over to Acorn either!

Is there any wordprocessing software that has a version that runs on an IBM PC and on the Archimedes so that we could both use and swap our data without too much trouble?

A The simpliest solution is to purchase a copy of Colton Software's *Pipedream 3* – an outstanding wordprocessor that works fully under the windows of Risc OS.

It is then a question of getting your friend to buy *Pipedream* for the IBM PC. This is totally file compatible with the Archimedes version so you can swap files between the two different computers with comparative ease.

Q I need to use my BBC micro for wordprocessing in Irish. Are you aware of wordprocessing packages that have a suitable font available? It is important that the wordprocessor is able to display the font on screen. What do you recommend?

A You will probably be best served by *Wordpower* from Ian Copestake Software, 10 Frost Drive, Wirral, Merseyside L61 4XL. This company supplies a Power Font (L1) which contains the characters which would enable you to write in Irish, as well as Danish, Dutch, English, Faeroese, Finnish, French, German, Icelandic, Italian, Norwegian, Portuguese, Spanish and Swedish.

Q I have been using a BBC micro for some years and now want to transfer some BBC Basic programs and some *Wordwise Plus* files to my newly acquired BBC A3000. What equipment shall I need?

A You will first need to purchase a disc buffer kit. This will enable you to connect your 5.25in discs to the A3000. Beebug supplies a suitable model. You will than need to purchase a piece of software called a DFS Reader module, again this is available from Beebug.

With these items you will be able to transfer files easily from 5.25in discs.

In addition, Computer Concepts produces a BBC emulator version of *Wordwise Plus* for about £10 that will make use of the *Wordwise Plus* files on your A3000.

If you have a problem with an Acorn micro, commercial software or a program you are trying to write then *BBC Acorn User* can help. The Post A Problem service guarantees to give you a personal answer within 10 working days for just £4.

Write out your problem with as much detail as possible and, if a program is involved, include a disc or cassette. Fill in the coupon at the bottom of this page and send it and your problem along with a cheque or postal order for £4 (including VAT) made out to Redwood Publishing. If you want recorded delivery add on the cost of this.

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Q **I am writing a Wimp based program for use with my BBC A3000 but unfortunately I am having some difficulties with designing the windows and the definition of the menus.**

Are there any software toolkits that I can use for helping me with the task? I know there are similar packages for the IBM PC.

A If the Risc OS skeleton program from last month's *BAU* is not sufficient for your needs, you will find *Archway* from Simtron, 4 Clarence Drive, East Grinstead, West Sussex RH18 4RZ will be most useful.

This will enable you, when programming in BBC Basic to easily build multi-windowed programs with pop-up menus, icons and mouse control of professional quality.

The package has all the tools, script shells, runtime code, a library of functions and procedures and extensive examples you should need.

Q **I have been using a Microwriter Quinkey attached to my BBC micro for some years. I am now considering upgrading to an A3000. I am interested to know whether I can continue to use the device with my new machine. I have been unable to trace the Microwriter company since it moved out of central London.**

A The Quinkey, with the supplied software, should run on the A3000 under the 6502 Emulator as long as it can be connected to the A3000 serial port or interfaced to an appropriate podule.

Incidentally the company that produced the Quinkey and the Microwriter is still in business. It now sells the Agenda portable and can be contacted on 01-685 0300.

Q **I have been using a BBC Master 128 with the educational package called *Fun School 2*.**

The programs are on tape and recently I upgraded my machine by adding a disc drive.

I have attempted to upload the program to disc and run *Fun School 2* from there. Although I have got the programs on disc they fail to work properly.

A The *Fun School* programs supplied on tape are not exactly the same as the versions supplied on disc and although you have transferred the programs successfully to disc, you will not be able to run them satisfactorily without a considerable amount of alteration to the program code.

Incidentally if you do succeed in getting the program from disc you will also have broken copyright.

Why not contact the supplier and see if it will do an official upgrade for you?

Q **I've just taken the plunge and upgraded to the BBC A3000. I am about to fit a Wild Vision 256 Genlock card and have been told by the manufacturers that the A3000 cannot be expanded any more once that is fitted.**

Is it true that the expansion possibilities of the A3000 machine are limited compared with the earlier Archimedes A310?

A The BBC A3000 as supplied only has room for one podule while the Archimedes A310 can have up to four podules if a suitable 4-slot backplane is fitted. (The Archimedes 4000 series has four slots fitted as standard).

Wild Vision is not totally correct when it states that no further expansion will be possible when you have installed the 256 Genlock card into your machine. A number of manufacturers are working on external podule possibilities. Contact Pres at PO Box 319, Lightwater, Surrey GU19 5PW and EMR at 14 Mount Close, Wickford, Essex SS11 8HG and Electro Music Research at 14 Mount Close, Wickford, Essex SS11 8HG for details of their podule expansion plans.

ACORN CUSTOMER HOTLINE

● Users of *First Word Plus* release 1 and 2 with an Epson LQ series printer with a cut sheet feeder may have experienced problems when printing documents longer than a page in length.

This is easily cured by editing out the 'Vertical tab to line' option within the (source) printer driver and then recreating the printer driver. How to edit the source printer drivers and re-create them is documented in both release 1 and 2 *First Word Plus* User Guides.

However, if you require further information Customer Services has an application note available which covers the operation in more detail. This refers to the specific pages of the *First Word Plus* User Guide.

To get a copy of this application note, please send an A4 SAE to Customer Services at the Fulbourn Road address which is given below.

● Many users have been experiencing problems driving the Qume Crystalprint Publisher from the parallel port of the Archimedes. Discussions with Qume have confirmed a problem existed in the firmware of the Qume Crystalprint.

The problem has now been fixed and you can obtain an upgrade free of charge directly from Qume Ltd, Bridgewater Close, Reading, Berkshire RG3 1JT. Tel: (0734) 584646

● Many of you will be aware that up until now the only way to obtain the Acorn Outline fonts and the Acorn Outline Font Manager was to purchase Acorn's *Desktop Publisher* package.

You will be glad to learn that Acorn has now released the fonts on separate discs.

The Font starter pack contains the Font Manager, Corpus Font, Trinity Font and Homerton Font. The NewHall Font will be released on a separate disc (this is also supplied with the Font Manager). The cost of the Font packs is £51.75. The product code for the Font Starter pack is SKF01 and the product code for the NewHall Font Pack is SKF02. Both products are available from your local Acorn Dealer.

● For people who wish to know more about the hardware of the A3000, Acorn has released the BBC A3000 Technical Reference Manual containing details about the circuitry of the machine.

This manual will be particularly useful to people who wish to develop internal or external expansions for the A3000. The manual contains details of the size the cards need to be plus the connections to the expansion port.

The manual is also supplied with circuit diagrams of the A3000. The recommended retail price is £29.95 and the product code is AKJ75. The manual is available from your local Acorn Dealer.

● Please note the upgrades from ANSI C release 1 and 2 to release 3 and the upgrade from the Arthur 1.2 Programmers Reference Manuals to the Risc OS Programmers Reference Manuals as detailed in the January 1990 edition of *BAU* expire on March 31 1990.

If you wish to take advantage of these upgrade offers please contact our Customer Services department before this date so that details of pricing and so on can be sent to you.

● If there are any specific topics that you would like to see covered by this column, please write to me at the following address: Peter Dunn, Acorn Computers Ltd, Customer Services, Fulbourn Road, Cherry Hinton, Cambridge CB1 4JN. That way I should be able to tailor this column to fit readers' needs exactly.

LETTERS Send letters to BAU, 20-26 Brunswick Place, London N1 6DJ



LEAP AHEAD

I suspect that Rupert Thompson's *Hemera* diary program (January 1990 *BBC Acorn User*) does not place the feast of Saint Matthias correctly in a leap year.



The extra day in a leap year is actually 24th February (six days before the Kalends of March in the Roman calendar). Saints' days, and even birthdays, falling between 24th and 28th February are properly celebrated between 25th and 29th February in a leap year.

So the feast of Saint Matthias actually falls on February 25th in a leap year.

If you look at a diary or almanac which specifically names 'leap year day' you will find it is listed as February 24th. It is not those born on February 29th in a leap year who miss out on birthdays three years out of four (they have their birthday on 28th), but it is those born on February 24th in a leap year who should worry!

Mr J Chambers
Surrey

In the published program, the feast of St Matthias is indeed misplaced by one day in leap years (as the pic shows). Although it is unlikely that St Matthias will complain personally, the correction given below will sort out his feast day and any other celebratory days you insert in the *Hemera* program.

```
 4020 k=4109:REPEAT
:k=k+1:RESTORE k:RE
AD Dd%,Mm%,m$
 4023 IF FNleap(Yr%
) AND Mm%=2 AND Dd%
>23 THEN Dd%=Dd%+1
 4026 n=FNday(Dd%,M
m%,Yr%):PROCread(n)
:record$(1)=m$:PROC
write(n):UNTIL m$="
```

THE SMALL PRINT

I must write and complain about the yellow pages in recent issues. Looking forward to putting in some interesting programs, I turn to the yellow pages and what do I see? That's the problem, I cannot see much.

Being over 50 and using glasses, I find it impossible to follow the size of the printing used. Is this a clever ploy to force people to buy the monthly disc, being the only way I can get a program into my Arc?

Comparing the March issues from 1989 and 1990, I see the page count has gone down, including the yellow pages.



Why do you print out the yellow pages at this 'ridiculous size' and poor as regards sharpness of image? The old style printing seemed a lot clearer.

There doesn't seem much point in printing listings that no one can type in.

A Benfield
Leicester

The yellow pages listings are now produced with a laser printer rather than the 9-pin dot-matrix printer of yesteryear, which gave varying results to say the least.

However, the size has indeed decreased. The number of programming articles has increased in *BAU* over the last few months, whilst the space available for the program listings is limited in each issue.

What's more, there are now more programs specifically for the Arc. Archimedes programs are often quite long, especially applications, so the need for extra space becomes more important.

So, the yellow pages have had to be 'compressed' to fit into this new size.

A lot of readers do prefer to type in the listings, especially to follow programs and learn from what they type. But of course, the monthly disc does have the advantage of 100% correct listings, plus any extra bonuses that are relevant to the particular month.

SOUND ADVICE

I read with interest your article concerning the *Armadeus* sampler in the January 1990 *BAU*. I own a BBC model B and for some time have been interested in sound sampling. Together with a friend I built an 8-bit sampler and linked it to the computer via the user port. The maximum sampling rate is 20kHz and the software covers the following areas.

Real Time Echo. Various effects are possible such as delay and feedback.

Osciliscope. Displays or stores an incoming sound (max. 20kHz) in real-time as a sound wave on screen.

Octaver. Doubles the incoming frequency and replays the sound in real-time.

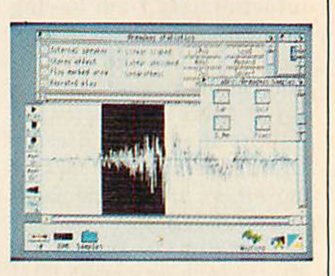
Fourier Transformation. Displays a sound wave on screen as a series of bars.

The software is by no means finished but the hardware is complete. I would like to market the product but do not know if there would be a market for it.

Richard Heath
Newcastle

Sound samplers have been produced for the BBC micro in the past. The Barry Box was quite popular in its time although it now looks a little dated against sophisticated Arc equipment such as Clares' *Armadeus* hardware and software.

From your specification, it seems you've pushed the Beeb to it's limits. The market for such an advanced product should not be a problem.



BELLS AND WHISTLES

I've just started a subscription to *BAU* because it is just about the only Beeb magazine to have regular pages of comms and music. Some more would be nice but I'm glad it's there.

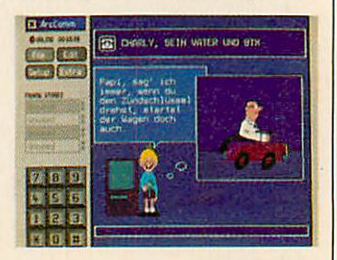
The new look is OK – quite neat really and very easy to find things.

While on the subject of comms, I've been running a bulletin board myself for the past month. The board is called Psyclone (not Cyclone) and is 24-hour viewdata/Colour terminal and runs at 1200/75, 75/1200 and 300/300 baud.

The number is (058283) 2653 and has a Beeb area, Ample area and an, as yet small, Archimedes area.

Keep up the good work on a great magazine.

M Carpenter



Psyclone

Thank you for your comments on the new design. We've had a lot of response to it, and most people seem to like the new look.

The Beeb's always been a popular computer for comms, and it's good to see it continuing with the Archimedes.

Any comms news should be sent to Dave Janda at the usual *BAU* address.

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NEXT MONTH Coming soon to BAU . . .

SUPPLEMENT YOUR DIET



We've had to raise the price of your favourite Acorn mag to £1.60 from the May issue, to reflect rising costs in producing the magazine.

However, by way of compensation, you'll find next month's *BBC Acorn User* adorned with a special supplement for DTP lovers. Discover what DTP can do for you and how to do it.

The May issue itself is heavily into the music scene. There's life in the Beeb's own capabilities yet, thanks to *Strum* – an all singing, all dancing auto-accompaniment music program that's fun to use and educational too.

Some more commercial educational music software comes under *BAU* scrunity and we have the famous *BAU* music column which next month reveals how to play samples with a Music 5000.

Next month also sees the secrets revealed for new display modes on the Arc and multiprecision arithmetic on the Beeb.

Plus, that old favourite, the game of *Life* gets brought right up to date with a version to get all creationists up in arms.

On the reviews front, Archimedes external disc buffers get a going over and Computer Concept's *Impression* DTP package is put up against the opposition.

We take a look at a cheap laser printer for Arc or Beeb owners and Computech's updated Integra B board for the Beeb.

And there's all the usual eyecatching goodies packing out the May issue – Risc Revue, Eight Bits, News and views and so much more in your sunny soar-away *BAU* – a bargain at twice the price.

WRITE IT IN YOUR DIARY:
MAY ISSUE OUT 12TH APRIL



EIGHT BITS

£10 SPLIT MODE UTILITY

This utility from Stephen Double of Epsom will allow you to incorporate two modes into your programs which will appear concurrently. He has made this task easier by the use of different PROCEDURES from within Basic. For example, one procedure assembles the actual machine code which uses a timed interrupt to switch modes (or just colours) part way down the screen. Other procedures allow you to change the default colours in a selected part of the screen or put text and graphics in a selected part of the screen.

The actual program given includes a demonstration of the utility. Of course these lines could be deleted if required. The first part shows how eight colours can be used in mode 1. The top part of the screen is programmed for physical colours 0-3 and the bottom part for physical colours 4-7.

The second part of the demonstration shows you how you can mix two different modes together. Unfortunately there are restrictions on mixing certain combinations of modes together because modes 0-3 run at a higher frequency clock than modes 0-7, 25-line modes will not mix with 32-line modes and mode 7 requires the use of an additional teletext chip which is incompatible with other modes.

So, you can mix any two of modes 0,1 and 2 or mode 4 and mode 5. Of course you can also mix, say, mode 0 with mode 0 and so get four colours on the screen at the same time (the demo shows how you can obtain eight colours by mixing modes 1 and 1).

Essentially you will have two independent screens, so you will have to inform the operating system which one you are using at any one time (by using PROCopen) as it does not expect more than one mode on-screen.

To use the utility in your own programs you will have to use most of the program given (bar the demo and PROCtriangles). The main procedure PROCassemble assembles machine code for the utility. This must be called before anything else. Labels in the machine code signify the following:

enable% enables the interrupt of the screen refresh
service% services the interrupt (the main code)
disable% returns to a normal single mode screen

PROCsplit(m0,m1,l) sets up the screen for a two mode display where m0 is the 'top' mode, m1 is the 'bottom' mode and l is the number of character lines taken by the 'top' mode. For example PROCsplit(1,2,10) sets up a screen consisting of 10 lines of mode 1 at the top and a remaining 22 lines of mode 2.

This procedure is normally called only once, but if it is necessary to call it again, you must call PROCdisable beforehand.

PROCopen(s) must be used before any text or graphical output is sent to the screen.

This allows text/graphical output to go to either the top or bottom part of the screen where s=0 indicates output goes to the top part of the screen and s=1 indicates output goes to the bottom part.

PROCdisable(m) disables the utility where m is the new mode. This procedure is only essential if PROCsplit needs to be called more than once.

PROCdefine(s,lc,pc) replaces the now redundant VDU 19 command (which will no longer function). For this, s is the screen number as outlined above, lc is the 'logical' colour to be programmed and pc is the required 'physical' colour.

FNadc(c) replaces the now redundant ADVAL command (ADC interrupts are disabled to stop the screen from jittering).

The parameter, c, is between 1 and 4 and replaces ADVAL(1/2/3/4) directly in a program.

Negative parameters for ADVAL and ADVAL(0) still work as before. This function, therefore, is only essential for joystick movement and the like.



You can use eight colours in mode 1, simply by splitting the screen

£10 VIEWSHEET FILES UNITED

Andrew Pillidge of Woking has sent us this utility for *Viewsheet* users. This is a program to join together two *Viewsheet* files. The program should be typed in from the yellow pages or run from the monthly disc and will display a screen asking for the filenames of the two *Viewsheet* files you wish to join.

These should be standard *Viewsheet* files, saved with the ordinary SAVE command. You are also asked to give a name for the new combined file.

The program opens each file and opens a file for output under the new name. The data is read in and the larger file created. The format for the large file is that the second spreadsheet is located 'under' the first, which means that the cells in the second sheet retain their original column letters, but the row number of each item is increased by the size in rows of the first spreadsheet.

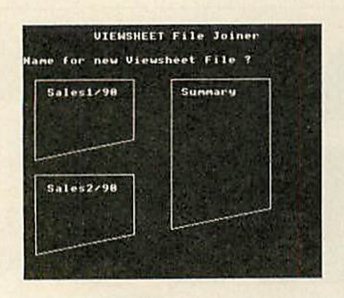
So for example, if the first sheet occupied an area A1 to

H12, and the second one extended from B2 to J24, then the new sheet would contain a copy of the first sheet in the original cells, and also the second sheet, transposed to cells B14 to J36.

The utility is primarily for handling lists of numeric data, such as actual month by month figures with labels.

Note that the program, being fairly short and straightforward, does not translate formulas. So if, say, a total in the above example is stored as C2C8, it will not be translated to C14C20 when the new sheet is created and neither will any other cells based on references (as opposed to absolute values).

To merge two sheets with correct formulas, you will have



to create the second sheet in rows below the bottom row on the first sheet leaving a blank gap above the second sheet, then run the merge program.

Upon loading the merged sheet, a number of blank lines will appear between the top and the bottom sheets. Delete a number of lines from this gap equivalent to the number of rows in the first sheet and everything should then be in its place. This can be facilitated by leaving a text marker such as **K1** in the cell K1 in the second sheet before merging. You will then delete blank lines in the merged sheet until **K1** is once again in it's correct place.

It is hard to explain how the program works, due to the complexity of the *Viewsheet* file format but if you are interested, studying the listing should show you the various operations involved.



£5 SPOOLON FOR THE BBC

Master 128 owners have a useful addition to the operating system in the *SPOOLON command, which operates in the same way as the *SPOOL command but instead of creating a new file, it appends spooled output to an existing file.

This allows you to collect several items of text information, without having to merge several spool files. The command is not available on the BBC model B or Electron DFS/ADFS/NFS but regular contributor Joe Abley has produced a machine code utility for these machines which produces the same effect. (It also works on the Master!)

To use the program, type in and run the listing which will generate a machine code program called SPOOLON. Keep the machine code program on a disc in your current drive and

type *SPOOLON <filename> where <filename> is also present on the disc. Any further VDU output will be spooled onto the end of this file, without destroying the file's existing contents. Spooling can be terminated with a *SPOOL command or a CLOSE#0.

The program works by reading the command line using OSARGS (A=1,Y=0). It then attempts to do an OPENUP on this filename using OSFIND (A=&C0). If there is no file of that name present, A=0 after this call and so a simple *SPOOL <name> is executed. However, if there is a file of that name present, the handle is stored and the SPOOLON code is executed.

The SPOOLON code works by first reading the extent (size) of the opened file, and writing the file pointer to be equal to this value, all using OSARGS. In other words it does the machine code equivalent of PTR#handle=EXT#handle.

Next, it calls OSBYTE (A=&C7) to write the handle of the spool file. Then it ensures that file spooling is activated by resetting bit 4 of the output stream control byte, as read by OSBYTE (A=&EC). This byte is rewritten using the same call, and with this done, spooling starts.

All very simple really, but effective.



One of the most inconvenient tasks for any Master 128 owner has to be the replacing of the brilliantly designed shrunk wrapped batteries for maintaining the Cmos Ram.

If you are fortunate enough to have a friendly Acorn dealer nearby then the purchase and installation of the battery pack is relatively harmless.

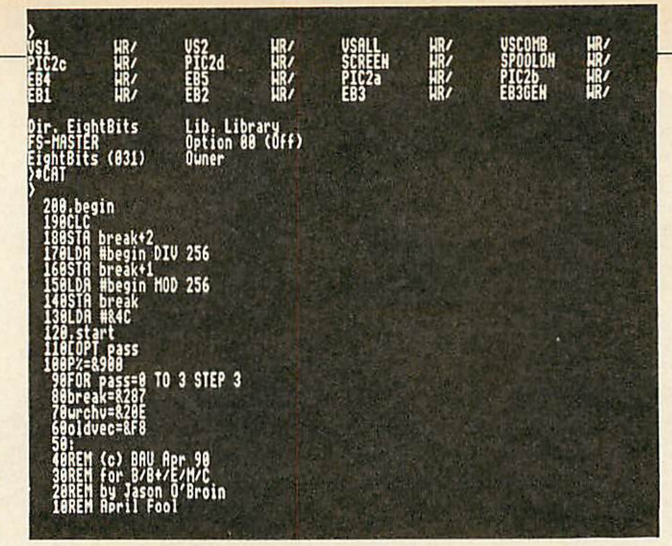
However, if you live miles away from your local dealer then it becomes rather more painful. This tip from Paul Walker of Hyde attempts to remedy the problem. It allows you to replace the batteries simply from the purchase of the normal blisterpack version of Duracell batteries.

Firstly, purchase a 4-cell battery holder (an in-line type – four cells side by side), a dummy battery and three new fresh Duracell batteries from an electronics supplier (such as Maplins or RS Electronics).

The standard Master 128 battery pack contains not only three Duracell batteries but also a most important diode. This diode stops the batteries corrupting the Cmos Ram by reverse voltage.

Save your Cmos Ram configuration first and then remove your 'nearly expired' battery pack. Prize open the battery pack to reveal the diode and carefully noting its orientation relative to the polarity of the batteries, remove the diode.

An alternative would be to determine the type of diode and purchase one together with the other components. Also remove the lead which connects the bat-



```
>
VS1        WR/     VS2        WR/     VSALL      WR/     VSCOMB     WR/
PIC2c      WR/     PIC2d      WR/     SCREEN     WR/     SPOOLON    WR/
EB4        WR/     EB5        WR/     PIC2a      WR/     PIC2b      WR/
EB1        WR/     EB2        WR/     EB3        WR/     EB3GEN     WR/

Dir. EightBits     Lib. Library
FS-MASTER          Option 00 (Off)
EightBits (031)    Owner
>*CAT
>
  200.begin
  190CLC
  180STA break+2
  170LDA #begin DIV 256
  160STA break+1
  150LDA #begin MOD 256
  140STA break
  130LDA #&4C
  120.start
  110[OPT pass
  100P%=&900
   90FOR pass=0 TO 3 STEP 3
   80break=&287
   70wrchv=&20E
   60oldvec=&F8
   50:
   40REM (c) BAU Apr 90
   30REM for B/B+/E/M/C
   20REM by Jason O'Broin
   10REM April Fool
```

tery pack to the circuit board.

Solder the diode into the dummy battery, remembering the orientation and install it in the 4-cell battery holder. Also solder the removed connection lead to the battery holder, again ensuring correct polarity.

The dummy battery has a metal link from positive to negative. This link should be broken and replaced with the diode, soldering it in place with the dummy battery.

Stick a piece of Velcro to the reverse of the battery holder and the matching piece in an appropriate position in the computer. Suggested positions are in the modem position if you don't happen to have one and on the lid if you have.

Insert the new batteries, plug it in, reload your Cmos configuration and off you go.

Should you put the diode in the wrong way, don't worry just turn it round.

However, your Cmos Ram may have been corrupted. Be very careful that you solder the main connecting lead correctly – red connects to positive (+) and black to negative (-).

One last point: Be very careful when carrying out these instructions. Getting the connections wrong could damage your Master's Cmos Ram permanently. If you are at all unsure about what you are doing, don't undertake it, especially if your machine is under warranty.

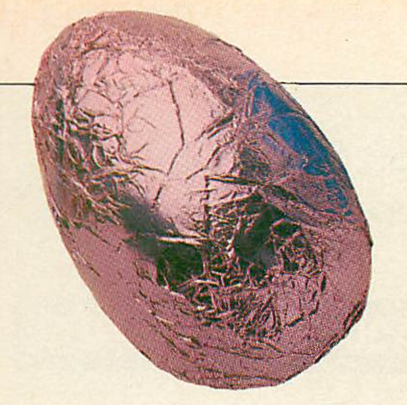
£5 APRIL FOOL

If you want to play an April fool trick on a fellow Beeb or Master owner, run this program from Eight Bits regular Jason O'Broin. A short machine code routine is installed which makes the carriage return character move up the screen, not down! Try running it, and pressing RETURN a few times or for that matter, just generating some text, with a *HELP or *CAT command!

MATTERS ARISING

There have been quite a few responses to previous Eight Bits items. Remember your feedback is always welcome but stands more chance of inclusion if it is fairly short and to the point. Additions of five or 10 lines do not need to be accompanied by a disc if you don't want.

Mr I King has supplied some improvements to Murray Mackenzie's *Wipe* program in





the October 1989 issue. The following lines should be added to the listing, which should then be reassembled:

```
 95 osbyte=&FFF4
395 LDA #15
396 JSR osbyte
485 CMP #27
486 BEQ end
675 LDA #124
676 JSR osbyte
677 JSR osnewl
725 EQUS " "
```

This provides flushing of any buffer characters to prevent accidental erasure, correct clearing of ESCAPE and a gap between the filename and the (Y/N) prompt.

Peter Russell from Norfolk has tried Jansci Suto's tip in the December 1989 issue of *BAU* (setting HT 1 27, then using highlight 1 followed by printer escape sequences) and says that he cannot get *View* to recognise any highlights without some printer driver installed.

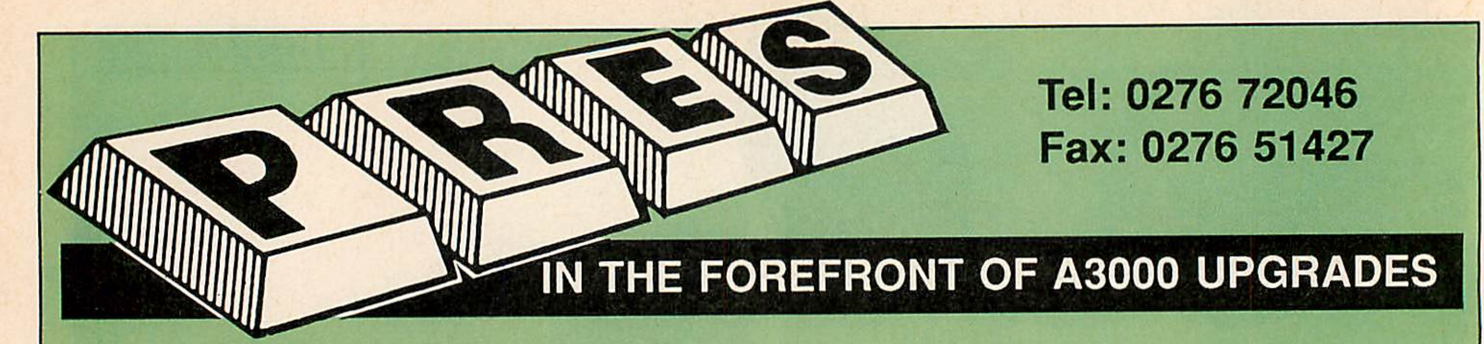
I have tried to verify this and it seems to be down to different versions of *View* – some do allow highlights to be translated even when there is no printer driver present and some don't. Another point to note about the technique is that you can still use the command HT 1 27 quite usefully when you have a driver loaded, to temporarily issue a special printer code, and then return to using the normal driver with the commands HT 1 128 and HT 2 130.

If your printer needs true binary 1s and 0s as part of its escape sequences and will not accept the Ascii equivalents then a useful way round this is to set highlight 2 temporarily to 0 and then to 1. For example, on an Epson MX80, underlining is turned on with ESCAPE,-,binary 1. To send this from *View*, you would set highlight 2 to 1 and then insert the sequence highlight 1,W,highlight2.

Andrew Pillidge has spotted a small error in his *View* Preview utility published in February. He wrongly assumed that *View* used location &18 for its 'start page' pointer, like Basic does. *View* in fact uses location &0C for this purpose and text starts at memory address ?&0C*256. You should therefore change line 300 of the program from LDA & 18 to LDA &0C and delete line 320.

That's all from me for this month. Keep those submissions coming, particularly on the applications side and for submissions with programs, remember to include in the text accompanying the disc a full description of how to use the program and how it works. About 400-500 words is about the right amount.

The text accompanying the program should be included on the disc along with the program. Send your BBC, Master and Electron submissions to Eight Bits, *BBC Acorn User*, 20-26 Brunswick Place, London N1 6DJ.



Pres is committed to providing a full range of compatible upgrades for the Archimedes A3000

The range starts with a carefully thought out monitor plinth 'A3K1' which allows the **A3000** to move freely back and forth making the most of limited desk space. In response from initial users we have also incorporated a way of preventing accidental access to the reset switch. Where security matters it is also possible to fix the plinth to a desk.
A3K1 is expandable to A3K2, a styled housing to take the **A3000** to a system. A3K2 is supplied with a post regulated, switch mode power supply and provides the means for adding up to 2 additional floppy drives (2 x 3.5" or 1 x 3.5" + 1 x 5.25") and a Winchester hard disc drive. All these can be added without having separate boxes hanging from the computer on ribbon cables.

PRES have also allowed for adding standard expansion cards (podules) on the rear of the machine. This is done by means of a casing which attaches and is fixed to the **A3000** case providing full protection for the expansion card. However it does not stop there. The case is expandable to take a backplane and expansion board which can accommodate FOUR mini cards. PRES will release the specification for the mini cards to any third party wishing to have their products on **A3000**. PRES are currently working on a range of Mini Cards, plans include . . . high spec analogue to digital converter, user ROM and battery backed RAM, SCSI, MIDI, 2nd. vdu.

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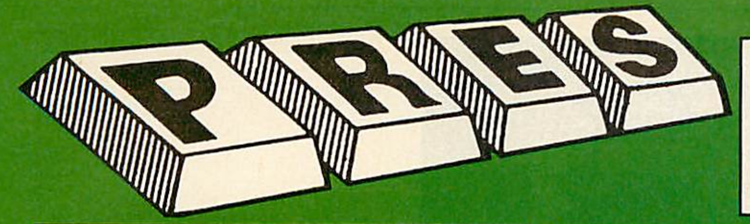
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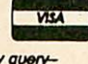
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RISC REVUE

£10 ALTERNATIVE AUTOMATION

We've received several ideas and suggestions about automatons since J E Connett's 'Demon' program appeared in February's Risc Revue. Dr D Fagandini of Dulwich had the idea of switching between two sets of rules for cell growth.

Rather than always looking at the cells on each side (left, right, above and below) or always at the cells on each corner, Dr Fagandini tried looking at the former for a few generations and then looking at the latter. Listing 4 on the yellow pages contains the extra lines necessary to try this out.

Simply add them to the original Demon program (on page 94 of February's issue) paying particular attention to the line numbers.

Run the new altered program and, as well as specifying the number of colours and colour offset, enter two 'periods'.

If, for example, you enter 1 and 1 then the two sets of rules – orthogonal and diagonal – will be used on alternate generations.

Dr Fagandini suggests using 15 colours with an offset of 40 with the periods both set to 150. So every 150 generations the rules will be changed.

The impression thus produced he describes as 'masses sliding over and under each other in three dimensions'. It's certainly a curious effect and well worth trying out.

As for my own efforts on the automaton front, listing 5 is my latest venture. Many automatons rely on a single type of cell, or at least, a single species of cell. This, I suppose, is one of the reasons why they are so fascinating.

However, I wondered what it would be like to have several species, each of which contains a variety of individuals. Listing 5 is the result.

Essentially there are four species – red, green, blue and cyan. Within each there are four classes of individual – 4 being the strongest and 1 the weakest. A square of randomly chosen cells is built up (generation zero) and subsequent generations are produced according to the following rule.

Each cell is taken and its neighbours examined. The total strength of all of these is calculated and also, the total strength of all the neighbours of each particular species. If the latter forms more than half of the former, the cell is taken over by the dominant species.

So, for example, if we were looking at the neighbours in each corner and found a red 3, a green 1, a blue 2 and a blue 3 the total strength would be 9 and that of the blue neighbours 5. The cell would thus become a member of the blue species because these form the majority of the opposing forces.

The strength of the new cell is chosen simply by taking the total strength calculated and stripping off the higher bits to leave a value 0-3.

Because the cells were randomly chosen in the first place, this system works quite well although ideally one should generate a random number for the new strength.

On running listing 5 you are asked to supply various parameters. First, give the square size. Obviously smaller squares lead to faster growth but larger ones look more impressive on-screen. The outcomes are similar whatever the size, so it's useful to try ideas out on a small scale to see how they progress in the long run.

Next, enter a set of pairs of offsets. These simply refer to the neighbours checked when producing the next generation. For example, check orthogonally using:

```
0,1  0,-1  1,0  -1,0
```

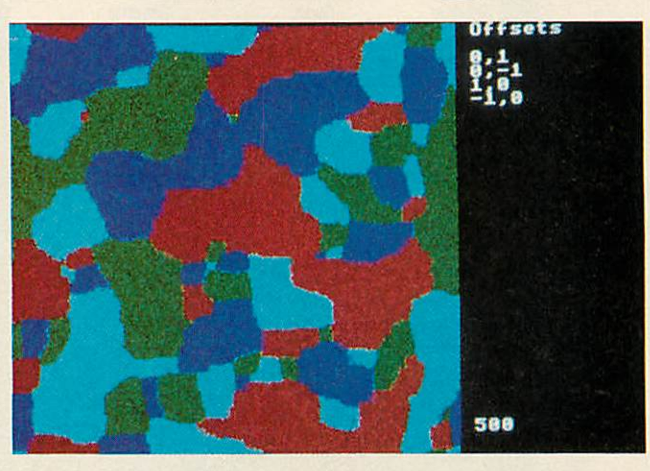
or diagonally using:

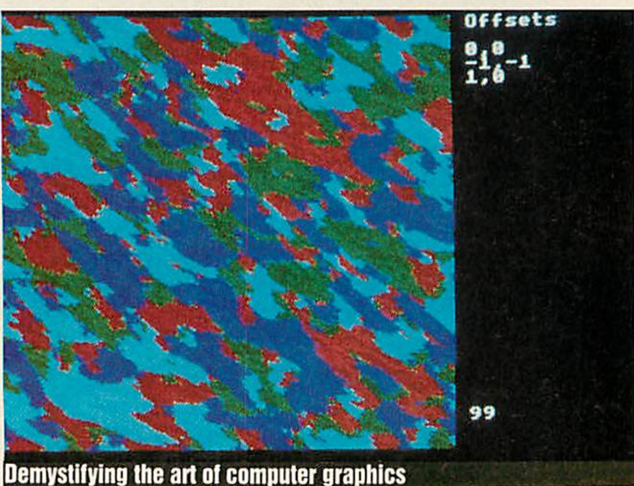
```
1,1  1,-1  -1,-1  -1,1
```

You may include the current square:

```
0,0  0,1  1,0
```

and the inclusion of a more distant neighbour can produce





Demystifying the art of computer graphics

some interesting tessellated effects:

```
0,1 0,-1 1,0 -1,0 5,7
```

Much of the variety of the patterns produced is derived from the random arrangement of cells of different strengths and; in some ways, the program might be seen as more 'authentic' in its simulation of simple lifeforms. You can see battles taking place on borders between opposing species.

If you are familiar with Arm code, you should be able to follow the listing. Note that the total strengths for each species are all stored in one register (total2) which explains all the shifting about in the middle.

If you are writing your own automaton (and, if you are, why not send it in when you've finished?) you might like to note a feature of listing 5 aimed at speeding up the generation process. Each neighbour-check is assembled by FNDO and, if one of the offsets is the same as the last check, it is not recalculated. So, entering:

```
1,1 1,-1 -1,-1 -1,1
```

will produce more efficient (and thus faster) code than:

```
1,1 -1,-1 1,-1 -1,1
```

although the results will of course be the same.

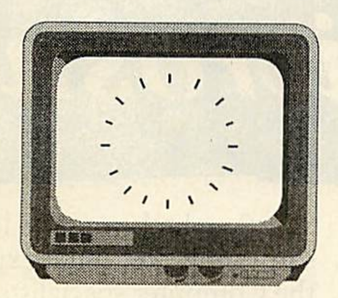
You might also like to note that the colours used in the automaton are stored in the DATA statement at the end.

The first four are the colours for individuals from species 1, the next four for species 2 and so on.

Try different values but remember to ensure that members of the same species have similar hues so that you will be able to see what's going on!

£20 SAVE THE SCREENS

I'm continually being pestered by the *BAU* goblins for something colourful on-screen with which to decorate these glorious sheets. So just to spite them, I found this program whose sole purpose is to switch the screen off.



It's a screen preserver – to turn off your precious monitor if no key or mouse button is pressed for a while and prevent the current image being 'burnt' on for all time. It comes from Jason O'Broin, something of a regular in these parts.

Enter listing 1 on the yellow pages and run it. A module called 'ScPres' is assembled and saved. Simply load the module with *ScPres or *RMLOAD ScPres to install the preserver.

Any key or mouse button click will instantly restore the display. You can specify the delay before the screen is turned off with the command *ScPres followed by the desired time in seconds, say, *ScPres 15. To switch off the preserver use *NoScPres or kill the module in the usual way.

The program works using events to detect key or mouse button presses and how much time has elapsed since the last one. The screen is switched off by talking to the memory controlled chip MEMC, telling it not to supply DMA refresh signals to the video controller VIDC. (For those new to the Arc, DMA stands for Direct Memory Access and, in this case, refers to the way in which the contents of the screen memory are extracted for display).

Listing 1 begins in a familiar way with the standard module header. The module initialisation code at .initcode claims a little workspace (24 bytes), adds the routine called event_handler to the 'chain' by calling "OS_Claim" and then enables three events.

These are 11 (key pressed/released), 10 (change of mouse button state) and 4 (Vsync).

The module finalisation code naturally disables these events and removes event_handler from the chain so the module may be killed humanely.

The Vsync event is used to count how many 50ths of a second have elapsed since the last key press. Each time an event 10 or 11 happens, the counter is reset but if the counter reaches the given time (the default being about three minutes) the screen is blanked.

The workspace location [R12,#4] contains 0 if the screen is on and 1 if it is off. This flag is checked after event 10 or 11 and, if 1, the screen is restored.

It is interesting to note that the machine actually goes a good bit faster with the screen turned off, much in the same way as programs run faster in mode 13 than they do in mode 15. It's easy to forget that the computer actually has to shift the display data about and this takes time.

ALL SORTS

One of the most useful yet unexpected SWIs you might come across within the more uncharted regions of Risc OS is the splendid "OS_HeapSort" – a wonderful little sort routine that could remove the pain of sorting things for ever more. The basic format of the call is:

```
SYS "OS_HeapSort",numobj,base,type
```

Self-evidently, 'numobj' is the number of items to sort, 'base' is the address in memory where they can be found and 'type' indicates what the items actually are. There are six types, shown in table 1.

0	cardinal number
1	integer
2	pointer to cardinal number
3	pointer to integer
4	pointer to string (case insensitive)
5	pointer to string (case sensitive)

Table 1 "OS_HeapSort" types

Table 1. "OS HeapSort" types

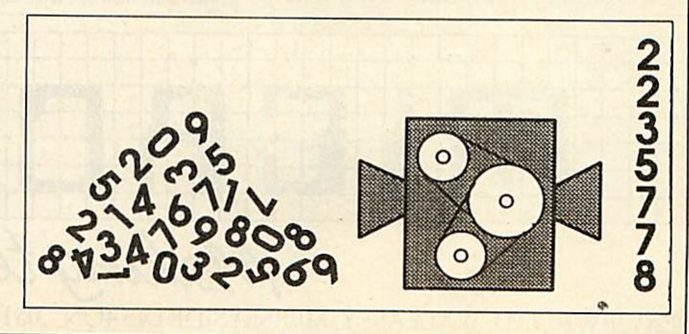
Listing 2 on the yellow pages demonstrates the simplest form of sort. A table of random integers is built up and then sorted. The speed of "OS_HeapSort" is really quite impressive – you might like to increase the value of objects% to really give it something to think about.

The ability to sort strings of characters is particularly useful and listing 3 demonstrates this. Again, a table is built but this time it contains pointers to strings stored in memory.

The sort call is the same except for the 'type' parameter which becomes 4 (or 5 if you want to take note of the case of the characters). Again, the speed is very impressive and it's nice that what would once have required a sizeable piece of machine code or a slow Basic procedure can be done using a single Risc OS call.

NOW DO YOUR BIT

Programs, ideas, hints and tips for Risc Revue are always very welcome. Send them to Risc Revue, *BBC Acorn User*, Redwood Publishing, 20-26 Brunswick Place, London N1 6DJ. Fame, up to £20 and even more fame await the select few. He, she or it who dares, wins.



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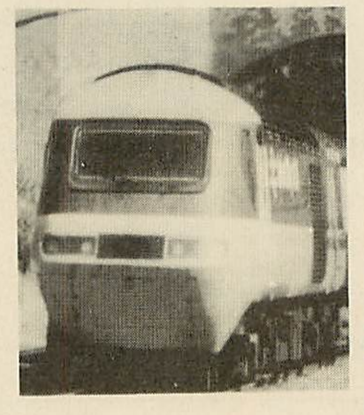
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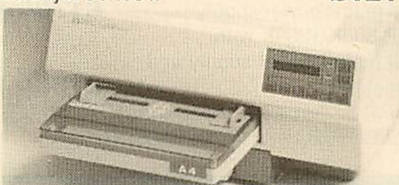
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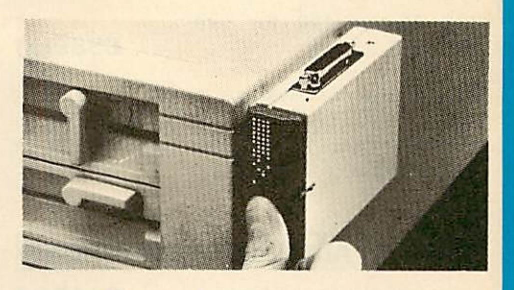
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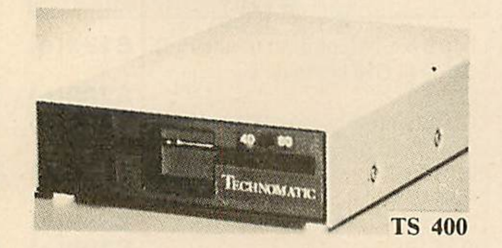
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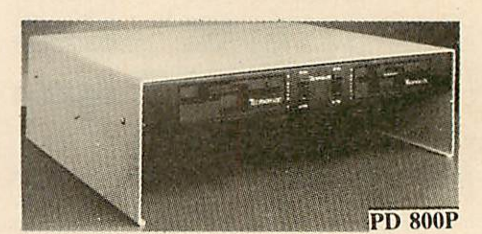
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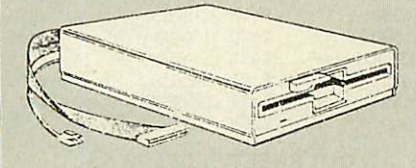
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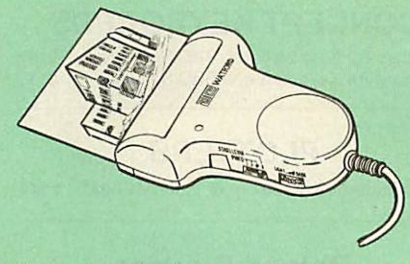
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Morley Teletext Adaptor with ATS Rom	£99
Filestore E01S £899 / Filestore E40s	£749
Filestore E60S £949 / Ecolink	£270

(Carr. £2 to £7 depending on the weight)

Archi Mk II Hand Scanner



Watford Electronics is now able to offer a complete hand held scanning package, possibly the most essential addition to any desk top publishing system. The package includes the most comprehensive utility software available for the Archimedes, a high quality, ergonomically designed to fit the shape of your hand, (see drawing above) scanner, which is fitted with a warning LED that will indicate if the scanner is being moved too quickly for accurate results. Additional twin guide rollers ensure precise tracking over the image, to make the best use of the high resolution available with this sytem. The yellow/amber illumination of our Mk II scanner, enables you to achieve optimum accuracy. It is capable of scanning upto an amazing 400 DPI. The scanning area is 4" wide and the height is only limited by the maximu amount of memory available.

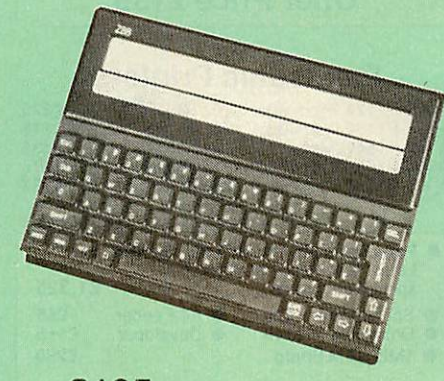
On board ROM software supplied, is the most sophisticated Archimedes scanner software yet written.

Launch offer £149 (P&P £4)

SPECIAL DISCOUNTS

For Teachers, Lecturers & Education. Please phone for further details.

Z88 Portable Micro



Only: **£195** (Carr £4)

FREE

With every Z88 purchased from us, we are giving away absolutely FREE, a Z88 to BBC Interface Link, 4 rechargeable batteries and a compact Mains Battery Charger worth £38.

ACCESSORIES

32K RAM Pack or 32K EPROM Pack	£18.00
128K RAM Pack or 128K EPROM Pack	£45
512K RAM Pack	£175
Z88 Eprom Eraser Unit	£35
Z88 Spellmaster for Pipedream	£51
Z88 Carrying Case	£9
Z88 Computing Book	£9.95
AA Nicad Rechargeable Battery	£1.50
Battery Charger Compact & Fast	£6
Z88 Serial Printer Cable	£9
Z88 Parallel Printer Cable	£25

● Z88 to BBC Link	£20	● Z BASE	£56
● Z88 to PC Link II	£30	● Z TAPE	£42
● Z88 to Macintosh	£52	● Z TERM	£42
● Z88 Mains Adaptor	£9	● Z88 Modem	£149

By popular demand, we are now supplying refurbished and fully guaranteed BBC Micros with Disc Filing System
(Please telephone for price & availability)

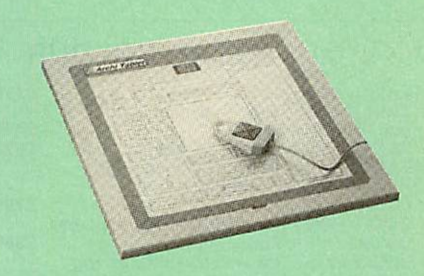
FINANCE AVAILABLE

In these days of expensive borrowing, we are pleased to have negotiated a special low rate finance deal for our customers, with flat interest rate of 12.25% per annum, typical APR 25.5%.

In addition to the above, we are able to offer all Archimedes and BBC Master computers as well as selected hardware on a 0% interest free finance deal.

For further details please telephone: 0923 37774 ext 223/203/201.

Archi Graphic Tablet



This package allows Archimedes users to take advantage of the low cost graphpad (sometimes called a digitiser tablet, but not to be confused with a video digitiser!)

The Archi Graphpad offers performance and accuracy comparable to other graphics tablets priced at well over £400, and has the useful addition of a liftable cover, which can hold tracing material or menu templates securely.

The software, which is in the form of a relocatable module (RM), intercepts the system calls which control the mouse, and so allows virtually all mouse based Archimedes software to be controlled using the tablet without any modification. The only exceptions are programs which use the serial port, as the tablet is physically connected to this port itself.

Graphics programs such as Artisan, Pro Artisan, AutoSketch, Oak DTP, and the RiscOS Draw, Paint and DTP packages are considerably enhanced by the use of the graphics table as opposed to the mouse, although it can, of course, be used with any other mouse driven application.

The software allows the user to define how much of the tabler's 12" x 12" working area to use, allowing very fine control when drawing freehand or tracing from a variety of differently sized drawings, diagrams, photographs, etc.

The tablet driver is compatible with all Archimedes machines, and with both Arthur and RiscOS operating systems.

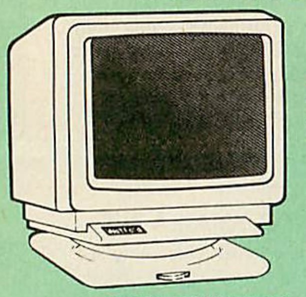
The pointer is moved via a four button puck complete with transparent lens and crosshairs for optimum accuracy. Three of the buttons emulate the Archimedes mouse buttons precisely, the fourth being used for special functions such as setting the position and size of the active working area. The buttons may be re-mapped to allow the relationship between tablet and mouse buttons to be redefined, should this be required.

The software is supplied with a special adaptor lead to connect the tablet to the Archimedes' serial port, and a power lead which plugs onto the Archimedes' main board.

Special Price £249 (carr. £4)
(Price includes Tablet, Leads & Software)
Stylus Optional Extra **£29**

Continued→ → → → → → → → →

MONITORS





MICROVITEC 14"

- **1431** – Standard resolution as used on the BBC television computer programme £175
- **1451** – Medium resolution, suitable for word processing in mode 0 £219
- **1455** – MS Medium resolution, ideal for Archimedes £220
- **1441** – High res, exceeds the capabilities of the BBC Micro £359
- **1431AP** RGB + PAL and AUDIO £199
- **1451AP** RGB + PAL and AUDIO £255
- **2030 CS** 20" Med Res £380
- **2040 CS** 20" Hi Res £675
- Dust Cover for Microvitecs £5.50
- **Touchtec 501 Touch Screen** £239

14" MULTISCAN COLOUR

- **TAXAN** Multisync 770 Plus £389
- **TAXAN** 770 LR Low Radiation, auto-scanning Ultra High Res £429
- **TAXAN** Multiscan 870 16" Monitor £575
- **TAXAN** Viking 19" Paper White, High Resolution (1152 x 896 with Archi 400 series) £799
- **EIZO** 8060H – For technical info. read the review in Micro User, Jan. '89 £389
- **EIZO** 9060SZ Low Radiation, Super High Resolution, Antistatic screen, multiscan monitor for a wide range of applications. 800 dots x 600 lines. Display for high res VGA. 0.28 Dot pitch £469

TAXAN 12"

- Super Vision 3 – **Type 625** Super Hi-res RGB Colour, Green/Colour Switch £269

PHILIPS

- **BM7502** 12" Hi-res Green Monitor £70
- **BM7522** 12" Hi-res Amber Monitor £71
- **CM8833** 14" Med. Res Colour Monitor £215

STAR BUY

- **PHILIPS 14"** Medium Res, dark glass, attractively finished Colour Monitor – supplied complete with RGB, SKART and Audio/Phono Inputs. A push-button switch toggles between Hi-Res monochrome green text mode and full colour display. (Please state the type of Connecting Lead you require)

ONLY £189

Dust Cover for Philips Monitors £6
(Securicor carriage on Monitors £7)

SWIVEL BASES

By simply placing your monitor on one of our front adjustable professional swivel bases (see drawing at the top), you can easily adjust the monitor viewing angle.

for 12" Monitors **£8** (carr. £2.50)
for 14" Monitors **£12** (carr. £2.50)

Anti Glare VDU Screen

These extremely effective, easy to install, 12" & 14" VDU screens eliminate harmful glare, improves contrast on colour monitors. Increases productivity in offices. A must for wordprocessor users.

Price £12

SPARE LEADS

BNC Lead for Zenith or Philips	£3
Skart Monitor Lead	£5
RGB lead for TAXAN Monitors	£3
Archimedes Colour Monitor Lead	£7.50

CONCEPT KEYBOARDS

Standard A3 Keyboard with BBC Software	£143
Standard A4 Keyboard with BBC Software	£117

PLOTTERS

- Plotmate A4S **£379**
- Plotmate A3M **£549**

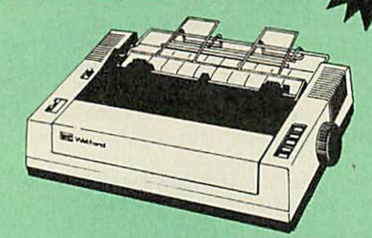
Roland Plotters

(Official Roland Appointed Distributor)

- **DXY 880A** £499
- **DXY 1100** £595
- **DXY 1200** £835
- **DXY 1300** £1015

Panasonic KX-P1081

12 months FREE maintenance on site



SALE OFFER only: **£127**

(Price includes, FREE a 4ft Printer Lead, and a Dump Out 3, Screen Dump ROM worth £35 with every printer purchased from us)

KX-P1180 Printer Offer

Panasonic KX-P1180 printer, Dump Out 3, Screen Dump ROM & a BBC printer lead.

Offer Price £136

Panasonic Printers

- **KX-P1124** 24pin 80col. 192/63 CPS £225
- **KX-P1180** 9pin 80col. 144/38 CPS £146
- **KX-P1540** 24pin 136col. 240/80 CPS £435
- **KX-P1592** 9pin 136col. 216/45 CPS £275
- **KX-P1595** 9pin 136col. 288/61 CPS £355

- **Panasonic KX-P4450i** LASER PRINTER Latest technology at Watford's special offer price **£1,325**
- Spare Toner **£29**
- A4 Feeder **£55**
- Drum Unit **£149**
- Developer **£115**
- 1MB RAM Board **£299**

Panasonic Accessories

Cut Sheet Feeders

KX-P1592/1595 (P32)	£175	KX-P1540 (P35)	£175
KX-P1124 (P36)	£85	KX-P1180 (P37)	£79

BUFFERS

P12	4K buffer Board for 1081	£55
P42	32K buffer Chip for 1592/1595	£16
P43	32K Buffer Chip for 1540/1124/1180	£16

Serial Interfaces

P17 P1081/1592 **£32** **P19** P1124/1180 **£55**

Original Panasonic Ribbons

Guaranteed to last 3 million characters

P110 for KX-P1081, 1592 & 1595	£8
P115 for KX-P1180	£8
P145 for KX-P1124	£8
P140 for KX-P1540	£10
Colour Ribbons for KX-P1081, 1592 & 1595 Brown, Blue or Red	£9.95 each

INTEGREX COLOUR JET

- Colour Jet 132 Printer £515
- Paper Roll £6.50
- Screen Dump Software £10
- Colour Cartridge £19.50
- Black Cartridge £11.25
- 100 A4 OHP transparencies £55
- 8K Serial Interface Optional £123

Citizen Printer Swift 24 £249

NEC P2200 PINWRITER £225

Pinwriter Serial Interface *(optional)*	£55
P2200 Cut Sheet Feeder	£59
Additional Font Cartridge	£25

NEC PINWRITER P6/P7 Plus

NEC P6+ 80 columns	£439	NEC P7+ 136 columns	£575
Colour Option	£74	Serial Interface	£73
Cut Sheet Feeder	£125		
NEC Ribbons for		P6 £8;	P7 £9.50

Hewlett-Packard Printers

HP Quiet Jet Plus	£437
HP Desk Jet Plus	£549
HP Paint Jet Colour	£719
HP LaserJet Series IIP	£855
HP LaserJet Series II	£1275
HP Laserjet II TONER	£85
1Meg Ram Add-on Laser Jet II	£349
1Meg Ram Add-on Laser Jet IIP	£275



Star Printers

LC10 Printer	£136	XB24-10 Colour	£410
LC10 Colour	£195	LC10 Ribbon Colour	£5
LC24-10 Printer	£215	XB24 Colour Kit	£35
NB24-10 Printer	£399	Cut Sheet Feeder	£55

EPSON PRINTERS

EX800	£429	LQ860 Colour	£510
EX1000	£564	LQ1050	£575
FX850	£315	LQ1060	£649
FX1050	£405	LQ2550+	£925
FX1060	£679	LX400	£132
GQ3500 Laser	£999	LX850	£195
LQ400	£198	SQ850	£490
LQ850	£459	SQ2550	£925
LQ550	£269		

CUT SHEET FEEDERS for

EX800/FX800/850/LQ800/850	£130
FX1000/LQ1000/1050	£175
LQ2550	£390
LX400/800/850/LQ400/500/550	£69

TRACTOR FEED for

LQ800 **£44**; LQ850/FX850 **£69**; LQ1050/FX1050 **£85**; LQ2500 **£90**; LQ2550 **£90.**

ACCESSORIES

- EX800/1000 Colour Option £55
- EX800/1000 Colour Ribbon £14
- LQ2500 Colour Option £65

(Securicor Carriage on Printers £7)

EPSON PRINTER INTERFACES

All these interfaces fit inside the printer

RS232	£32	RS232 + 2K Buffer	£52
IEEE 488	£40	RS232 + 8K Buffer	£79

PRINTER LEADS

BBC Centronics 4' long	£5
BBC Centronics 6' extra long	£7
Compact's Special Centronics Lead	£7
Archimedes Printer Lead 1 metre	£6
Nimbus Centronics Lead	£6
IBM Parallel Lead 1 metre	£6
Double Ended 36 way Centronics Lead 4'	£7
Double Ended 36 way Centronics Lead 6'	£9
MSX Centronics Parallel Lead 4'	£12
RS232 Leads (Various)	P.O.A.

Listing Paper (Perforated)

- 1,000 Sheets 9.5" x 11" Fanfold Paper £7
- 2,000 Sheets 9.5" x 11" Fanfold Paper £11
- 1,000 Sheets 9.5" x 11" NCR 2 Part Fanfold £19
- 1,000 Sheets 15" x 11" Fanfold Paper £9
- 1,000 Sheets true A4 Fanfold Paper 70gms £11
- 2,000 Sheets true A4 Fanfold Paper 70gms £19
- Teleprinter Roll (Econo paper) £4

(All our Fanfold paper is Micro perforated leaving a smooth clean edge when the tractor feed strips are detached).

Carriage 1K Sheets £2.50, 2K Sheets £3.00

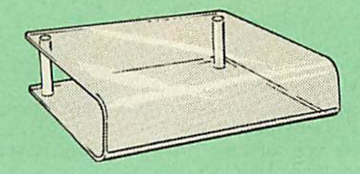
PRINTER LABELS

(On continuous fanfold backing sheet)

1,000 90 x 36mm (Single Row)	£5.00
1,000 90 x 36mm (Twin Row)	£4.90
1,000 90 x 49mm (Twin Row)	£7.50
1,000 102 x 36mm (Twin Row)	£6.25

Carriage on 1,000 Labels £1.00

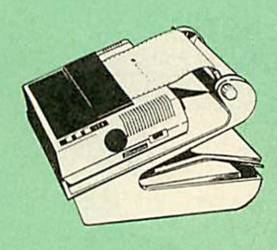
Perspex Printer Stand



Give you Computer System a touch of Class with our elegant, smoke finished Perspex Printer stand.

80 Column version **£16** (carr £3)
136 Column version **£20** (carr £4)

Professional Printer Stand



This new professional printer stand takes hardly more space than your printer. Due to the positioning of the paper feed and refold compartments ie. one above the other, the desk space required for your printer functions is effectively halved. Additional facilities include: Easy access to paper from both sides, used with both top and bottom feed paper and with its dial controlled paper feed system with adjustable deflector plates it ensures smooth paper flow and automatic refolding.

80 Column version £23 (carr. £3)
132 Column version £26 (carr. £4)

Printer Ribbons & Various Dust Covers

Type	Ribbons	Dust Covers
Brother HR15/20	£3.00	–
BBC Micro	–	£3.50
BBC Master	–	£4.00
Archimedes Micro pair	–	£9.00
Citizen 120D	£3.95	£4.50
RX/FX80/MX80	£3.00	–
DMP2000	£3.75	£4.75
EX/LQ800	£4.50	£4.50
EX/LQ1000	£6.75	£5.00
RX/FX80/85/800/MX80	£3.25	–
RX/FX100/1000	£5.00	–
Kaga/Taxan KP810/815	£4.90	£5.00
LQ500/550/800/850	£4.50	£6.00
LQ1050/LQ2500	£7.00	£5.50
LX80/86/800/850	£3.25	£4.50
M1009/GLP	£3.80	£3.75
NEC P2200	£6.00	£5.00
Panasonic KX1080/81	£3.50	£4.75
Panasonic KX-1124	£8.00	£5.00
SQ2500	£23.00	£5.50
Star LC10/NL10	£4.25	£5.00
Star LC24-10	£5.00	£6.00
Olivetti Ink Jet Cartridges (set of 4)	£9	

Our attractive Dust Covers are manufactured from translucent PCV. The seams are stitched and edges are taped to prevent splitting due to continuous use.

Universal Printer Sharers/Changer

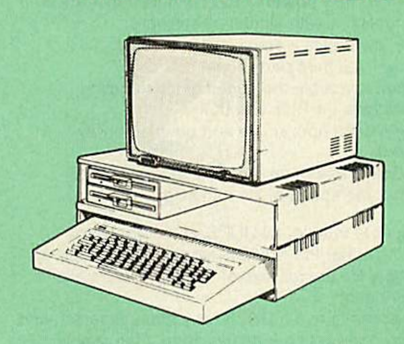
Connect upto 5 Micros to 1 printer or 5 Printers to 1 Micro with our combined, Sharer/Changer. These Units are made to a very high standard. For extreme reliability, they all have Printed Circuit Boards mounted inside the case, (not a Spaghetti Junction of wires). Internal connection is made via high quality ribbon cables.

(Ideal for School environments)

Connects	Serial	Centronics	P&P
2 to 1	£20	£22	£3
3 to 1	£27	£30	£3
5 to 1	£36	£39	£4

(Cables extra at £6 each. Please specify type required when ordering)

PLINTHS FOR BBC MICRO, MASTER & PRINTERS



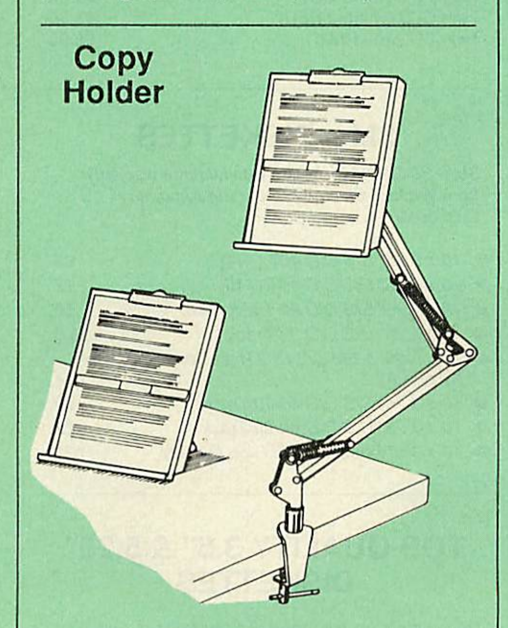
Protect your computer from the heat of your VDU. Our micro plinths have slots for maximum ventilation. The single plinth is suitable for a BBC and VDU, whilst the double height version provides enough room for our stacked disc drive and other peripherals like, Eprom programmer, music unit or simply discs & stationary. The computer slides neatly in the lower section allowing easy access to remove the lid.

The single printer stand is equally sturdy but instead of cooling slots it has elegant cutouts on the sides. This allows easy access to paper from all sides. Colour: BBC Beige.

Single BBC Plinth	420 x 310 x 105mm	**£13**
Double BBC Plinth	420 x 310 x 210mm	**£24**
Printer Plinth	420 x 310 x 105mm	**£12**
Single Master Plinth	490 x 310 x 105mm	**£14**
Double Master Plinth	490 x 310 x 210mm	**£26**

(Carr. Single plinth £2; double plinth £3)

Copy Holder



Whether you want to type in your latest program or the draft of a new trilogy, Watford's manuscript holders are superb for holding you paper at the ideal height and angle to allow you to read and type in ease and comfort.

Available in 2 full A4 versions, desk resting and shelf clamping. Paper is held firmly by means of a plastic retaining ruler and a clip grip. (for resting books or magazines, the desk top version is recommended).

Desk Top **£7** (carr. £3)
Angle poise **£12** (carr. £3)

Handy Printer Switch

A handy two way compact printer switch that enables you to connect 2 Micros to 1 printer, or 2 printers to 1 Micro. Attaches easily to your printer, monitor, etc. A low cost solution for educational establishments. Ideal for those wishing to use a dot matrix and a laser printer. Available in two configurations.

Compact AB Switch Centronics	**£19**
Compact AB Switch RS232	**£18**

(Cables extra at £6 each)

MEGABUFFER 256



The Smallest 256K Printer Buffer Unit in the world **38mm x 130mm x 134mm.**

This new Megabuffer 256 from Watford is a full featured 256K Printer Buffer. The features are:

- Improves efficiency by making more efficient use of computer and printer.
- Compatible with any computer and printer that uses Centronics Parallel connections including all BBCs, IBM PCs, etc.
- Total compatiblity with all software.
- Cheaper phone bills when using your Modems.
- Ideal for those doing large graphics screen dumps that are slow to print.
- Multi-Copy facility allows you to print several copies via Megabuffer without going through your computer.
- Data Dump facility is included.
- Built in text unit for both the buffer & your printer.

Only £119 (carr £5)

Payment may be made by credit card, Connect card or cheque, but we also have available a range of finance terms, see the feature in our advert.

THE EPSON RX-FX-KAGA

Printer Commands Revealed

So you bought yourself a new printer, because the salesman in the shop showed you how clever it is and impressed you are with all sorts of printouts to show its capabilites – he may even have offered you a special price.

However, now that you have got it home and connected it to your BBC microcomputer, you are wondering how to make it perform these magical tasks. The manual seems to give no clues, and when you type in the example programs, the computer throws the LPRINT statements back in your face.

Now what do you do, when this £400 piece of high technology refuses even to move its head, and you have stayed up until 2 in the morning with copious supplies of coffee, desperately trying to print something out? Once again, Watford Electronics comes to your help with our new book entitled 'THE EPSON FX-KAGA PRINTER COMMANDS REVEALED'.

This book describes in plain, easy to understand English, how to use and make the most of your KP810, PW1080A or any other Epson FX80 compatible printers like Panasonic KX-P1080/1, etc., with the BBC Micro, both from Basic and Wordwise.

It describes in detail how to obtain the maximum in graphics capability from your printer and includes full indexes allowing you to cross index the numerous commands. Every command is explained in detail, with an accompanying BBC Basic program and an example of its use from Wordwise.

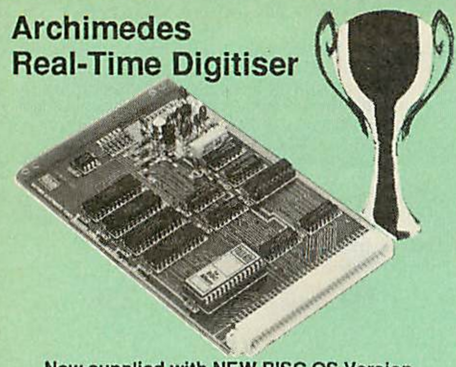
£5.95 (No VAT)



CREDIT CARD 24 HOUR Ansaphone Hot Lines (0923) 50234 or 33383

Continued→ → → → → → → → →

Archimedes Real-Time Digitiser



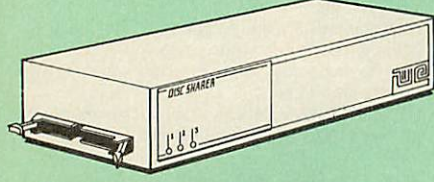
Now supplied with NEW RISC OS Version Software

Watfords' Archimedes Video Digitiser is the most sophisticated digitiser ever designed for a micro. It provides a fast and flexible means of capturing images from a video camera or recorder for display and manipulation on the Archimedes range of Micros. Off-air televison signals may also be digitised via a video recorder or TV tuner. Please write for further details.

Price £249

A Set of Colour Filters for colour image grabbing using a video camera	£16
New Risc-OS Software Upgrade	£39

DISC DRIVE SHARER



(Ideal for educational establishments)

At last, a low cost alternative to the Econet system. Watford's Intelligent Disc Drive Sharer allows you to connect 3 BBC micros (model B, B+ and Master series) to a single or double disc drive. Running under any DFS or DDFS, this intelligent unit will automatically queue the computers. Each computer has a status light dedicated to it. If it is green you will get immediate access to the disk, and red means that you are next in line. The unit plugs directly into the disc drive socket on each computer and is powered by the mains. (N.B. Not for use with ADFS.)

Launch Price : **£65** Price includes 3 Cables

DISC PLONKER RACK



When using ones micro, there is a tendency to have more than one Disc on the desk. This exposes them to the harzards of fingerprints, scratches, dust, coffee and an untidy desk.
Why not protect your valuable data from all these hazards with the help of our extremely handy and low cost DISC PLONKER RACK. Holds up to eight 5.25" discs.

Protection at Only: £2

Acorn & Watford DFSs

- Watford sophisticated DFS ROM — £16.00
- Watford DFS Kit complete — £69.00
- We will exchange your existing ROM for Watford's ultimate DFS ROM at only — £12.00
- DFS Manual (comprehensive) — £6.95
- Acorn DNFS ROM — £17.00
- Acorn ADFS ROM only — £25.00
- Acorn 1772 DFS ROM Kit — £49.00

(The single Density DFS system is now old technology. Like Acorn, Watford too have decided to replace it with the their more up-to-date 1770 DDFS interface. We have informed most of the software houses of this decision in order that they can ensure compatibility with our highly sophisticated and fully Acorn compatible DDFS).

Watford's MkII 1772

Single/Double Density DFS

Many of our customers have wanted to use our superior DDFS and Acorn ADFS together. Now our Mk II DDFS Board with its 1770 Disc Controller, has been adapted to allow the use of Acorn ADFS as well. It also has all the commands of the Acorn's 1770 DFS, plus the added features.

Added features include:

- Acorn ADFS compatible – Use ADFS on our DDFS board.
- Tube host Code – No longer any need to have the DNFS in your machine to use Co-Processors, even the CoPro and Master 512.
- Auto 40-80 Track sensing – no need to fuss with 40/80 track switches (even works with protected disks).
- An extremely powerful 8271 emulation – ensuring compatibility with almost all software.
- New low profile – small footprint board.
- Fits with all third party ROM boards.
- Option to double the speed of file handling operations – BPUT and BGET.
- Operates in both single and double density modes.
- OSGBPB has been recoded, increasing still further the speed of file handling.

Please note that not all DDFS's are capable of providing either the full 80% storage increase or of allowing a file the full size of the disk – Ours allows both of these!
If you already have a DDFS (any manufacturer), and wish to upgrade to our MkII version, then simply return your existing ROM and DDFS board and we will supply the new DDFS for only **£39.00.**

- SPECIAL PRICE — £44.00
- DDFS Manual — (No VAT) £6.95
- We will exchange your existing DFS Kit for our sophisticated DDFS for only — £30.00

Please note, as the MkII DDFS is a hardware and sofware upgrade, it is not possible for existing Watford DDFS users to simply exchange the ROM for the new version.

DUST COVERS (For our Disc Drives)

Single CLS (without PSU)	£3.20
Single CS (with PSU)	£3.25
Twin CLD (without PSU)	£3.85
Twin CD (with PSU)	£3.90

3M – DISKETTES

3M – SCOTCH Diskettes with Lifetime warranty from Watford Electonics your 3M Appointed Distributor

- *10 x 5.25" S/S D/D 40T (744)* — *£5*
- *10 x 5.25" D/S D/D 40T (745)* — *£7*
- *10 x 5.25" S/S D/D 80 Track (746)* — *£8*
- *10 x 5.25" D/S D/D 80 Track (747)* — *£9*
- *10 x 5.25" 1.6M D/S D/D High Density for IBM XT and AT* — *£14*
- *10 x 3.25" S/S D/D 40/80 Track* — *£9*
- *10 x 3.25" D/S D/D 40/80 Track* — *£9*
- *10 x 3.5" Double Sided High Density* — *£22*

TOP QUALITY 3.5" & 5.25" DISKETTES

To complement our range of Quality Discs and Disc Drives. WE are now supplying SPECIAL OFFER packs of 10 Lifetime guaranteed discs. Each disc has a reinforced hub ring. Supplied complete with selfstick labels and a Plastic Library Disc Box.

- *10 x **M3** 3.5" D/S D/D 80 Track* — *£9*
- *10 x **M9** 3.5" D/S High Density* — *£22*
- *10 x **M4** 5.25" S/S D/D 40 Track* — *£5*
- *10 x **M5** 5.25" D/S D/D 40 Track* — *£7*
- *10 x **M7** 5.25" D/S D/D 80 Track* — *£9*
- *10 x **M8** 5.25" D/S H/D Hi-Density* — *£13*
- ***M2** 3" Double Sided* — *£3 each*

FLOPPY HEAD CLEANER KIT

The heads in floppy drives are precision made and very sensitive to dirt. The use of cleaner Kit is a sensible precaution against losing valuable data. It is recommended to clean the drive head once a week. it is very simple to use. Available in 3.5" & 5.25", please specify.

Price £4

ANTISTATIC LOCKABLE DISC STORAGE UNITS

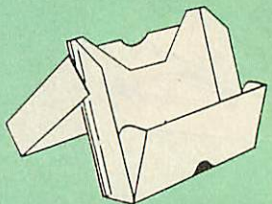


Gives double protection – Strong plastic case that affords real protection to your discs.
Antistatic helps avoid data corruption whilst in storage. The smoked top locks down.
Dividers and adhesive title strips are supplied for efficient filing of discs.

- **M35** – holds up to 50 5.25" discs — £4.95
- **M85** – holds up to 95 5.25" discs — £6.95
- **M25*** – holds up to 25 3.5" discs — £4.95
- **M50** – holds 50 3.5" discs — £6.50
- **M10** – holds 8 of No. 10 Data Cartridges — £15

* Not lockable

PLASTIC LIBRARY CASES



Holds up to 10 5.25" Discs. Only £2.00

DISC ALBUMS

Attractively finished in black leather-look vinyl. Stores up to 20 discs. Each disc can be seen through the clear view pocket.

£4

Special BULK OFFER on 5.25" DISCS

(Supplied packed in Anti-Static Lockable Storage Units)
(Lifetime warranty on Discs)



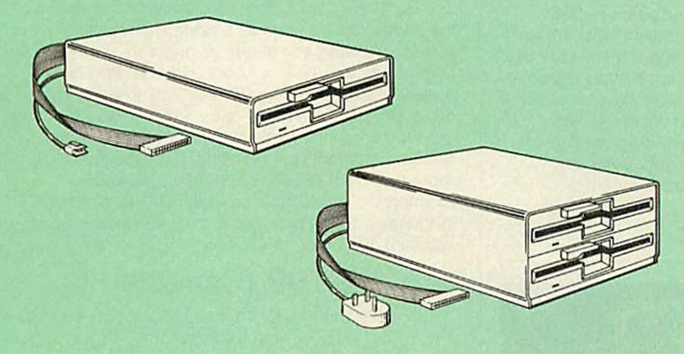
BULK PACK DISCS in lots of 100

Type	S-S 40T	D-S 40T	D-S 80T
Without Sleeves	£30	£35	£40
With Sleeves	£33	£38	£43

Quality Disc Drives from Watford

To help you decide which drive is the most suitable for your needs (and your pocket!), we have produced the table below.
This 30 Megabyte hard disc is completely compatible with the Acorn ADFS – that's why we have bundled it with each Winchester drive, along with an Utilities Disc.
The tinting on some of the boxes is used to indicate which Drives are 40 track (non-tinted) and which are 80 track (tinted). All our 80 track drives are already fitted with a 40-80 select switch.
All our Disc Drives are Double Sided and will operate in both Single and Double Density modes. *Extensive experience of the usage of disc drives suggests that the JAPANESE drives currently represent about the best in terms of speed, reliability and overall "elegance" available for the BBC Micro.*
Various UK "manufacturers" of disc drives for the BBC micro (more accurately, "packagers" label other manufacturers drives with their own name). We buy the high qulity NEC and Mitsubishi drives in large quantities directly from the manufacturers, package them and sell them at "dealer" prices direct to the public. If you look around the popular BBC micro press, you will find that the prices we quote for the top quality, new slimline disc drives are, virtually without exception, some of the best around. These prices, coupled with the backup of one of the country's largest distributors of BBC peripherals provides a superb deal.
Unless you anticipate using dual drives in a fully expanded BBC system for long periods of time with little ventilation, then we suggest that our range of "CL" disc drives without the PSU (Power Supply Unit) would be quite adequate (extensive tests within our workshops have confirmed this). All drives are supplied complete with a SPECIAL UTILITIES Disc, Cables and Plugs. The Drives with power supply have a mains moulded plug for safety purposes. ***Ideal for Schools & Colleges.*** *We are now able to supply all single disc drives with Power Supply, in either single or dual case. (Dual case has a twin data cable and a power supply capable of driving two disc drives) allows easy expansion to a dual drive unit, at a later date. Prices stated in the pricing boxes below are for single drives in standard single cases. Single drives in a dual case cost an extra £18. (At Watford we anticipate your needs of tomorrow, not just today!)*
When using a BBC Micro, most people find themselves short of desk space. The Watford's BBC Micro plinths form an ideal way of recovering some of this precious space) your BBC Disc Drive and Monitor can all occupy the same vertical footprint and still be comfortably situated. With the Watford Double plinth, your Disc Drive is mounted vertically at one side, leaving a very valuable area directly in front of you for such useful items as spare discs, pen, paper, reference manuals, etc. Follow the trend with a Watford plinth. *(Turn to the 4th page of our advert for the Plinths).*
P.S. All our 5.25" Disc Drives with PSU are compatible with the Compact Micro. All you require is the special Compact Disc Drive Cables designed by us.

Our Disc Drives conform to BS415



"Test Bureau Approved for Use in Education"

Capacity	Drives without P.S.U.		Drives with P.S.U.	
	Single	Twin	Single	Twin
400K (720K)	CLS400S £75	CLD400 £168	CS 400S £85	CD400 £188
800K (1,44M		CLD 800S £153		CD 800S £163

● TWIN Disc Drive Case, complete with Power Supply & Cables **£43**
Securicor carriage on Disc Drives £6 to £7

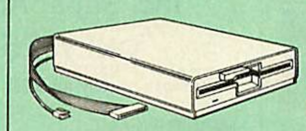
Prefix *C = Cased Drive*
L = Less PSU
S = Single
D = Double

Suffix *S = 40-80 Switchable*

e.g. *CLS400S = Cased Disc Drive, Less power supply unit, single 5.25" 400K, (720K in double density); Double sided; 40/80 track switchable.*

Cable to connect 5.25" Disc Drives to BBC Compact
Single £9 Twin £12
Special Cable to connect both 3.5" and 5.25" Disc Drives simultaneously to the BBC Compact £13

Special 40/80 Disc Drive/DDFS Mk II Offer

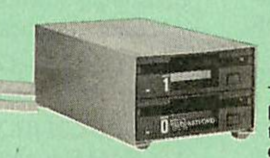


● The popular 40/80 track 400K single Disc Drive, Double Sided, cased with Cables. Plugs directly to your Micro.

● Watford's extremely popular DDFS Disc Interface (allows 720K storage). Will run in both Single & Double Density modes.

● A comprehensive User Friendly Manual.

A Bargain at Only **£119** (£7 carr) (Offer valid while stocks last)



3.5" DISC DRIVE OFFER

These top quality 3.5" Double sided, 80 track, 1 Megabyte (unformatted each Disc Drives), are attractively finished in BBC beige. They are supplied complete with all cables and a Utilities Disc.

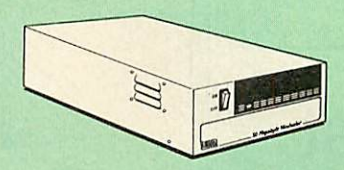
Drives to connect to BBC Micros own PSU

● **CLS35 400K Unit £65** ● **CLD35 Twin 800K £119**

Drives with built-in Power Supply Unit

● **CS35 Single 400K £85** ● **CD35 Twin 800K £129**

(P.S. CS35 Single is supplied in a twin case with a blanking plate to enable easy expansion to a dual drive at a later stage).

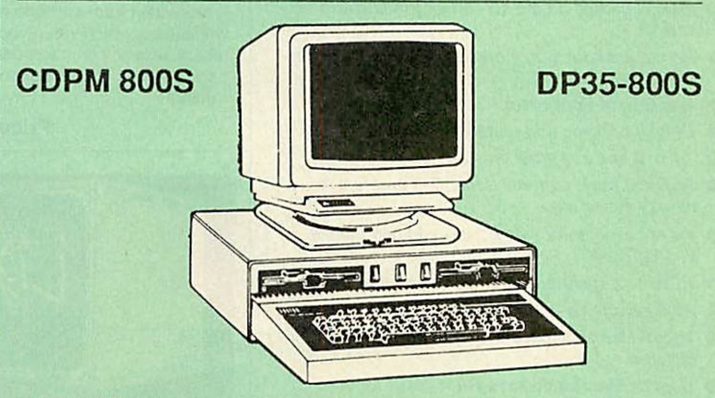


WATFORD's WINCHESTER DRIVES

Undoubtedly the best value for money Winchester Hard disc available anywhere for the BBC Micro.
This 30 Megabyte hard disc is completely compatible with the Acorn ADFS – that's why we have bundled it with each Winchester drive, along with a Utilities Disc.
Finished in rugged metal and fetching BBC beige, the Winchester has an internal fan, so quiet you won't even hear it! A switched mode power supply and a neon-lit on/off switch are there along with a light on the hard disc to tell you when it is working – just compare the price with our competitors' 20 or 28 Mbyte discs!
Compatible with the Master, and the BBC B (with 17 X disc interface).

● 30 Megabyte BBC Hard Disc **£369** (carr £9)

CDPM 800S DP35-800S



Twin 800K Double sided 40-80 track switchable disc drives mounted in an attractively finished Beige colour plinth for the BBC Micro. Supplied complete with integral power supply, cables and Utilities disc. The mains switch with neon On/Off light indicator, and the two 40/80 track switches are mounted on the front panel for ease of use.

CDPM 800S for the BBC B & Master £175

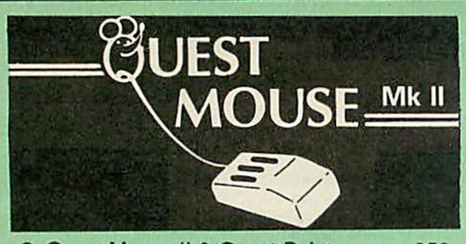
A Double disc drive with a difference! Times are changing fast for the floppy disk, and whilst the current standard for the BBC B and Master series is the 5.25" disk, the standard of the future will most certainly be the smaller; faster and more reliable 3.5 inch disks – now a standard feature of both the Master Compact and the Archimedes Series.
To support the present disc drive users, and cope with the future, we have designed our own plinth-mounted disk system – called the DP35 800S. It contains both the 5.25 inch and the 3.5 inch drive formats as well as offer a firm and rigid support for a monitor on top. With the BBC Micro underneath, the plinth makes a surprisingly small footprint on the desk – leaving you more space to work with.
The 5.25" disc drive is 40/80 track switchable. DP35-800S has its own power supply, independent of the BBC Micro.

DP35-800S for BBC/Master £165

(Securicor Carr. £7)

(The above drive units are 2 Megabytes unformatted)

Continued→ → → → → → → → → →



- Quest Mouse II & Quest Paint £58
- Quest Mouse II, Quest Paint, AMX Stop Press & Pagefont £89
- Quest Mouse II only £29
- Quest Paint Software only £34
- Quest Font Disc (22 Text Fonts) £15
- Quest Mouse Mat (Red or Blue or Green please specify) £3
- Part Exchange your unreliable AMX Mouse for a Quest Mouse for only £22

(P.S. Quest Paint is not compatible with BBC Compact)



Winner of the BBC Acorn User 1990 Award for the Best Art/ Graphics software



Quest combined with ConQuest and Acornsoft GXR ROM make up THE MOST POWERFUL drawing packages available for the BBC range. Quest Paint is able to take advantage of almost any additions to your machine, such as Shadow or Sideways RAM. ConQuest takes this principal even further, by utilising the otherwise normally incompatible Sideways RAM facility by holding pictures in them.

Some of the features are:

- *Pick filenames off the screen for loading and saving.*
- *Rotate a cutout to any angle and Distort it to any four sided shape.*
- *Has Built in Font editor.*
- *Default brushes and patterns on startup.*
- *16 x 16 font available on start up.*
- *Ability to reset patterns, fonts and brushes to default at any time.*
- *ROM based enhanced Epson and compatible printer dump.*
- *ROM based enhanced extended picture routine.*
- *Ability to create and abort extended pictures.*
- *Improved disk access speed for extended pictures.*
- *User definable sideways RAM driver for incompatible sideways RAM systems.*
- *Ellipses at any angle on Master 128 (or B with GXR ROM).*

ConQuest ROM Package £30
(Price includes software in ROM and a comprehensive Manual).
(Not Compatible with BBC Compact)



ARCHI Mk II MOUSE

An extremely reliable replacement mouse for Archimedes Micro £39

RB2 Marconi TRACKER BALL

RB2 (AMX/Quest compatible)	£45
RB2 including Quest Paint	£75
RB2-A for Archimedes	£52

THE NEW Mk III AMX MOUSE

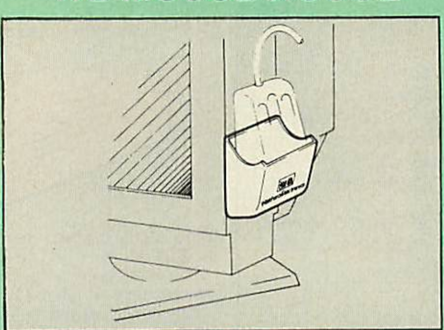
Inc. Super Art package

ONLY: £59 (carr £3)

(Please specify for BBC, Master or Compact)

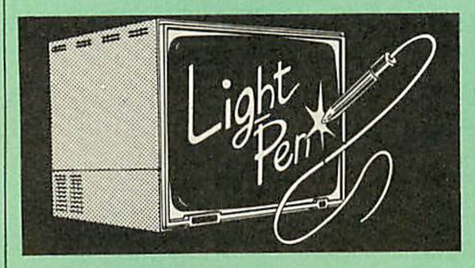
MOUSE MAT	£3
AMX MOUSE ONLY	£29
AMX SUPERART Package	£34
AMX STOP PRESS – A Desktop publishing software. Works with Keyboard, Joystick or a mouse	£32
PAGE-FONTS – Over 20 Fonts for use with AMX Pagemaker	£13
AMX DESIGN (ROM)	£55
AMX XAM Educational	£15
AMX EXTRA EXTRA	£16
AMX MAX A gem of desktop (ROM)	£20

WE MOUSE HOUSE



Treat your mouse to a cosy Mouse House. This handy little gadget solves the problem of where to store your mouse when it is having a rest. Made of sturdy plastic, the WE Mouse House attaches to the side of your computer, monitor, disc drive or desk. It protects it from damage when not in use, yet within easy reach when you need it again. There is also a second compartment for your pens and pencils – and at £4 it doesn't cost a rodent's ransom.

Price £4



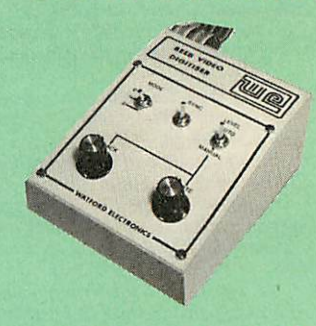
Our Mark II Light Pen is the very latest in light pen technology. It is totally insensitive to local lighting conditions and works with many different monitors. The pen only responds to the High Frequency light produced by your monitor/TV. An LED indicates when valid video data is being produced. A conveniently located switch is also fitted. (Price includes FREE software Disc and Operating Manual)

Only £21

FLEET STREET EDITOR

Software pack for BBC Micro	£33
Software pack for the Master	£39
Admin Xtra Disc Utility	£13
Walt Disney Disc Utility	£13
Fonts N Graphics Disc Utility	£13

BEEB VIDEO DIGITISER



"Test Bureau Approved for Use in Education"

Using any source of composite video (colour or monochrome) and the Watford Beeb Video Digitiser, you can convert an image from your camera into a graphics screen on the BBC Micro.

This uses the full graphics capacity of the BBC micro in modes 0, 1 or 2. The video source may be a camera, video recorder or television, and is connected via the video output socket.

Images produced can be compressed, stored to disc, printed on an Epson compatible printer, directly used to generate graphics, analysed for scientific and educational use or converted to other formats e.g. Slow Scan TV or receiving a picture from a remote camera using a modem. The output from the digitiser exactly matches the graphics capability in each mode, with up to 8 levels of grey in mode 2. The unit connects into the User Port and automatically scans a complete picture in 1.6 seconds.

Both the black and white levels can be adjusted manually for the optimum picture, or switched to automatic for unattended use. The image produced can be reversed if necessary.

Full controlling software is supplied on a normal sideways ROM and this is easily accessed via additional ★ commands. The package is designed to allow easy input of complex screens and give full access of the data to the user. Once on the screen, the image can be used as a normal graphics screen, allowing any of the usual graphics commands in BASIC or other ROMs to work on it.

A special print dump routine is included with the driver programs. This is specially designed to produce a fast, correctly proportioned picture, with reduced "contouring", resulting in an accurate reproduction of the original image. Detailed examples of driving this unit from BASIC or other languages are all provided in the extensive manual supplied.

£109 (Carr. £5)

(BBC B+ and Master compatible, except Master with Econet)

(Price includes) Digitiser Unit, Software in ROM & a Comprehensive Manual)

Magazine Maker

(As seen on TV)

A combination of Stop Press and Watford's Beeb Video Digitiser.

Using any video that provides a composite signal and the digitiser, images from a camera or TV can be converted into a graphics screen on the BBC Micro.

They can then be used within Stop Press to illustrate magazines or newsletters – in fact anything that needs to be created on A4 size paper.

With Stop Press's many features, a variety of pictures can be composed – the only limit being the imagination.

Pictures can be doctored using Stop Press's graphics option to produce any number of effects.

Text can be formatted around the digitised photo on screen using the facilities available, which include 16 typefaces, character and pattern definer, text formatting and the ability to load in Wordwise and View files plus much more.

Once created the picture can be printed out.

The Magazine Maker is suitable for any use that requires illustrated documents.

Complete Package **£135.00** (carr. £3)





Winner of the BBC Acorn User 1990 Award for the Best DTP/ Word Processor

The WAPPING EDITOR

The Wapping Editor from Watford Electronics represents a breakthrough in Desktop Publishing for the Beeb. The package includes a 64K ROM containing ALL the software needed to get into print fast; a very sophisticated graphics module, professional quality typesetting software, a word processor, a comprehensive font editor for designing your own typefaces, and a variety of printer dumps. This mouse-driven system is designed for the BBC B, the B+ and Master computers and will take full advantage of any Sideways and Shadow RAM that may be fitted. It will run under DFS, ADFS and Network filing systems and requires as a minimum just a single 40 track drive.

Included with the system is a utility disc containing several high quality fonts, various utilities and a ROM image of a Support ROM. A comprehensive 100 page manual completes the package. The Support ROM contains routines to allow an area to be rotated to any angle or distorted to any four-sided shape. Also included are facilities to draw ellipses at any angle and sectors, segments and arcs (in Master or BBC B with Acorn GXR). Another of the features of the Support ROM is a 'Turbo DFS' which gives DFS access times comparable with those of ADFS.

PAGE LAYOUT SECTION

The Wapping Editor may be used to create pages of any size from an A6 to a full A3 page. If none of the eight default page types suit your purpose, the stand-alone page creation program may be used to create pages to your own requirements. By using proportionally spaced fonts and genuine microspacing it is possible to print over 150 characters across an A4 page. A unique feature of the Wapping Editor is the 'A5 x 2' page size allowing two A5 pages to be printed side by side onto a single A4 sheet.

The graphics module is a mode 0 version of the highly acclaimed Quest Paint package, and incorporates all the same drawing facilities, e.g. pencil, brush, airbrush, polygon, circle, ellipse, fill, cut-and-paste, etc., etc.

Text may be typeset, either justified or unjustified, in any font anywhere on the page. Simply select which font and text document you wish to use, and pull out a rectangle on the page where you want the text to be – it's as simple as that! Multiple columns may be printed just as easily and a special 'expand' feature may be used to expand the microspacing so that the document exactly fits the space defined.

WORD-PROCESSOR

The integral word processor is the ideal tool for producing your text documents, although text can of course be read in from any of the other popular word processors such as View, Wordwise etc.

cont./-

THE FONT EDITOR

The font editor module will allow you to design your own typefaces or to modify the ones provided on the utility disc. This sophisticated editor has numerous functions designed to take the tedium and frustration out of producing good looking, well balanced fonts. Each character may be individully proportionally spaced and characters of any size up to 16 x 16 pixels may be defined.
Upgrading to the Wapping Editor could not be easier since the font editor will convert fonts from other packages, such as Quest Paint or Stop Press (formerly Pagemaker), into Wapping Editor format and a mode conversion utility will convert any screen in modes 1, 2, 4 or 5 into a full grey-scale mode 0 screen. Pictures may also be 'grabbed' from a video source by using the Watford BEEB Video Digitiser, either independantly or from within the Wapping Editor package.

Wapping Editor Software Pack	£69
Wapping Editor plus Mouse	£89

(Wapping Editor only works with Master Compact if a Mertec Expansion box is fitted)

Wapping Art Disc

Over 250K of clip art to cut and paste into your Wapping Editor pages. Pictures include maps, transport, people, media, sport, games etc.
Two 'ratio' screens for use with hi-res and rotated A5 pages to ensure images are not distorted when printed out.

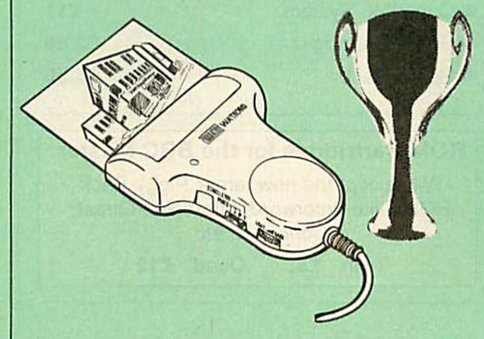
Music writing symbols in the form of pattern and brush for quick production of manuscripts are included together with staves.

There are two prepared hi-res pages layed out for printing labels, both single and double width. Ready made label designs are included but these can be easily replaced with your own designs.

A Mode 0 screen dump routine is also included. To pack such a large amount of data onto the discs the screens have been compressed and routines to compress and expand Mode 0 screens are included on both discs. Using the packing routine you can archive large numbers of screens onto a single disc.

£15

The Beeb HandScan
Hand-held Scanner for the BBC Micro



Watford Electronics are pleased to announce the launch of the first hand held scanner for the BBC Micro. HandScan is a compact unit which will allow photographs, diagrams, or any other documents to be digitised quickly and easily, to then be used in a desk top publishing package, art program, or even in your own Basic programs! These useful devices have been available for faster and more expensive micros for some time, but only now is Watford Electronics able to offer the BBC Micro computer.

The HandScan plugs directly into the 1MHz bus on the BBC while a comprehensive set of utilities provided by the sophisticated ROM firmware. The scanner has a resolution of either 100 DPI or 200 DPI when accuracy is essential. Pictures as wide as 4" may be scanned in mode 0 and various types of dithering may be selected to simulate the grey levels of a scanned picture.

All necessary software has been included in the firmware to allow the scanner to read images directly into our Wapping Editor with little more than the click of the mouse. The digitised picture may then be incorporated into your magazine, newsletter, report or any other document.

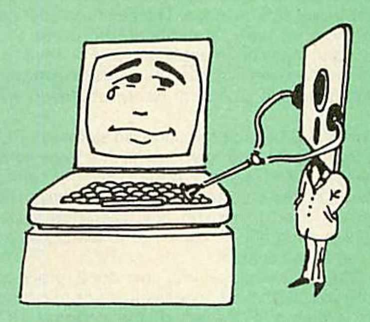
Beeb HandScan & Firmware	£135

Wapping Font Disc

Sixteen Wapping Editor fonts including smaller versions of Oberon and Daisy and two new sizes of the standard font.
Also included are three Mode 0 screens containing giant 'headline' fonts to cut and paste to create extra smooth headlines.
Supplied complete with instructions.

£12

DIAGNOSTICS DISC



The BBC Micro is a very complex machine and thus diagnosing a fault can be very difficult. At Watford Electronics, we realise how difficult it can be when faced with a problem, finding yourself a long way from your nearest dealer, or even just uncertain about your Beeb's health, but not wanting to waste time and money taking it to be looked at.

The solution to these problems is here now, in the form of the Watford's Diagnostics Disc. This excellent utility is specially designed to test out the following areas of your Beeb:

RAMs, ROMs, ULAs, Sound, Keyboard, Disc, RS423, ADC, User Port, Printer Port, Cassette, Joysticks, Speech, Disc Drives, 6502 and Z80 2nd Processors.

This utility is an invaluable aid for all those who take the reliability of their system seriously. A comprehensive manual provides full operating details and a list of possible causes and remedies for any faults that you may find along the way. The package also enables a permanent equipment and service record to be maintained.

Only £20.00

(Only suitable for BBC B with 8271 DFS)

> Payment may be made by credit card, Connect card or cheque, but we also have available a range of finance terms see the feature in our advert.

NEW

Beeb DOS 2.2

The BBC and IBM PC's are the most popular micros in the UK. The BBC is firmly established in the education sector and the IBM is the industry standard in the business world. The pools of information and applications held on these computers are immense, yet the means of passing information between them are very limited. Beeb DOS provides a practical method of transferring information between these two micros.

Beeb DOS is a collection of utilities which run on the PC's and enable it to read and write information on BBC discs. You can transfer files between your PC's 360K floppy, high density floppy or hard disc and your BBC discs. In addition Beeb DOS allows you to catalogue, format and compact BBC discs and delete, re-name, lock and unlock BBC files, all on PC's. Each Beeb DOS utility is written in IBM assembler and is run directly from PC or MS-DOS. The Beeb DOS utility can be run from floppy disc, hard disc or RAM drive.

Beeb DOS is supplied on an IBM 5.25", 360K disc complete with a comprehensive operating manual. (Will only work on 360K Disk Drives)

Price: £39

(Please write in for technical literature)

Continued→ → → → → → → → →



ARIES CORNER

B-32 Shadow RAM Card

Like the BBC B+, the B32 provides 20k of shadow screen RAM and 12k of sideways RAM. Unlike the B+, the B32 has simple software commands which allow the user to reconfigure the RAM as 16k of shadow RAM and 16k of sideways RAM, or all 32k as sideways RAM.

With the B32, the programmer gets up to 28k of RAM available for Basic, Logo, Cobal, Forth, Lisp and BCPL programs in any screen mode. The business user gets extra memory for View, ViewSheet, Wordwise Plus, Interword and many other applications. For advanced applications, the scientific user gets access to a massive 47k of data storage using the Acorn approved ★FX call.

Sideways RAM enables you to load sideways ROM images from disc, allowing you to have a large library of sideways ROMs (subject to the copyright holder's permission) stored on disc. The B32's sideways RAM can also be used to extend any operating system buffer (such as th printer buffer) or to load tape programs into a disc system.

The B32 simply plugs into the 6502 processor socket on you BBC micro – no flying leads to connect and no soldering. Provision of the onboard ROM socket means that the Aries-B32 control ROM does not use up one of your existing ROM sockets.

- Recommended by Computer Concepts for use with their Inter series of ROMs.

Price: **£69** (carr. £3)

Aries B-12 Sideways ROM Board

The B-12 provides a total of twelve sideways ROM sockets (the four in the original machine are replaced by the twelve on the board), all fully accessible by the MOS sideways ROM system. In addition, there are two sockets for sideways RAM, giving up to 16k of RAM using 6264 static RAM chips.

If you do not have a B32 or B20, a small adaptor module (the Aries-B12C) is available at a nominal cost

Price:	Aries B-12	£36
	Aries B-12C	£5

ARIES B-488 IEEE-488 INTERFACE UNIT

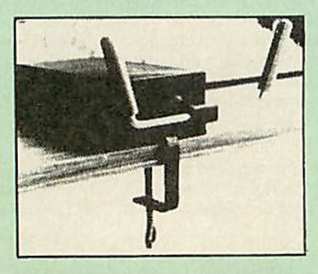
The Aries-B488 is an interface unit to enable the BBC micro to control and monitor IEEE-488 bus systems. The IEEE-488 bus (also known as the 'GPIB or 'HP IB') is the standard method of interconnecting programmable laboratory instruments and control equipment. Using the B488, up to 15 devices may be connected in a single high-speed data network.

£238 (Carr £3)

VOLTMACE JOYSTICKS

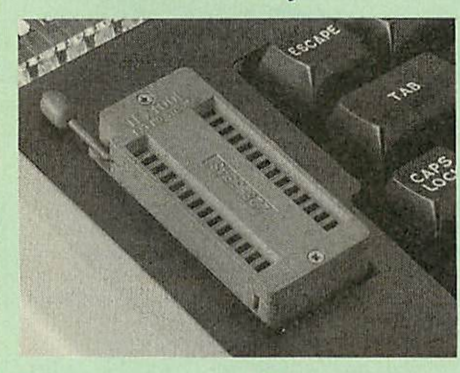
Delta 3B Single Joystick	£10
Delta 3B Twin Joysticks	£15
Delta 3C Joystick for Compact	£10
Delta 14B Single Joystick	£11
Delta 14B/1 Adaptor Module	£12
Transfer Software Disc-Tape	£7
Delta-Cat A mouse eliminator Joystick for the Archimedes	£24

Delta Base B



Analogue aircraft style yoke Joystick to run in the analogue port of the BBC B & Master 128 — £25

Sideways ROM ZIF Socket System



Allows you to change your ROMs quickly and efficiently, without opening the lid. The ZERO INSERTION FORCE (ZIF) socket is located into the ROM Cartridge's position.

- Very simple to install. NO SOLDERING required. The ZIF (Zero Insertion Force) eliminates the possibility of damage to your ROM pins when inserting & extracting.
- The low profile of the socket allows unrestricted access to the Keyboard.
- All data and address lines are correctly terminated to ensure correct operation of suitable ROMs with the BBC micro. We also supply a purpose designed see-through storage container with anti-static lining, allowing you to store up to 12 ROMs, protecting them from mechanical and static damage.
- This versatile hardware solves the problem of running out of socket space. Simply lift the ROM from the ZIF & insert a different one (No pulling or pushing of Cartridges. It is a must for professionals and Hobbyists alike.)
- BBC, B+ and Master compatible.

ONLY **£18** (carr £3)

Low Profile CARTRIDGE SYSTEM

Complete System consists of: Low profile ROM Cartridge, Socket housing, Cable assembly, 5 labels and a library storage rack for the BBC B.

● Complete System	£11
● Spare Cartridges	£2.50
● Spare Rack	£1.50

ROM Cartridges for the BBC Master

Will accept the new larger Piggy Back ROMs like: Interword, Interbase, Quest, Conquest, etc

Twin **£8**; Quad **£12**

16K DISC RAM

(16K Sideways RAM Module)

Complete with such features as read and write protection, these new modules from Watford Electronics are ideal for the hobbyist, software developer and ROM collector.

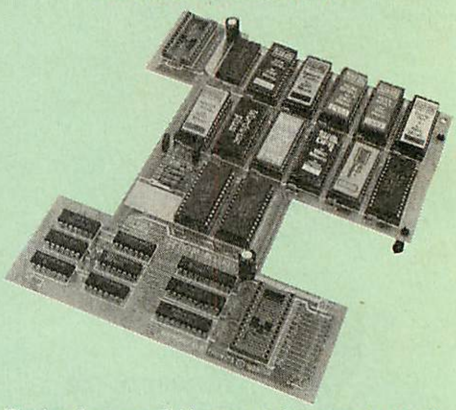
Key points to note about this new addition to the Watford range of products are:

- Write protection (useful in a variety of circumstances)
- Compact construction
- Supplied complete with Battery Backup.
- No overheating or overloading problems.
- Free utilities disc supplied
- Can be used as a 16K PRINTER BUFFER.
- Ideal for profressional software development.
- Supplied with utilities software disc.

Only: **£32** (carr £2)

P.S. 16K Disc Ram Board is not designed to work in conjunction with a Sideways ROM Board.

SOLDERLESS SIDEWAYS ROM SOCKET BOARD



The key features of this new, no fuss, easy to install quality product from BBC leaders Watford Electronics are as follows:

- Increase your BBCs capacity for ROMs from 4 to 16.
- **No soldering required.**
- Very low power consumption.
- Minimal space required.
- Compatible with Torch, DDFS, RAM Card, 2nd Processor, etc.
- Socket 14 takes two 6264 RAM chips.
- Read protect to make RAM "Vanish") allows recovery from ROM crashes.
- Battery backup option for RAM chips.
- Supplied ready to fit with comprehensive instructions.

Price: Only £35
Battery Backup fitted **£39**
Battery Backup only **£3**
16K Sideways RAM **£8.50**
(carriage £3)

- Sideways RAM Utilities Disc for Solderless ROM Board. Includes the options to load and save ROM Images and the facility to use Sideways RAM as Printer Buffer.

Only: £8

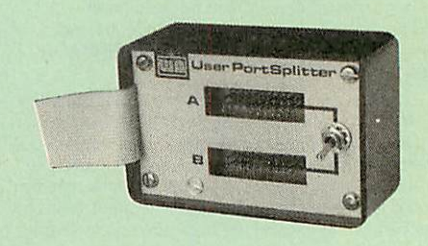
FINANCE AVAILABLE

In these days of expensive borrowing, we are pleased to have negotiated a special low rate finance deal for our customers, with flat interest rate of 12.25% per annum, typical APR 25.5%.

In addition to the above, we are able to offer all Archimedes and BBC Master computers as well as selected hardware on a 0% interest free finance deal.

For further details please telephone: 0923 37774 ext 223/203/201.

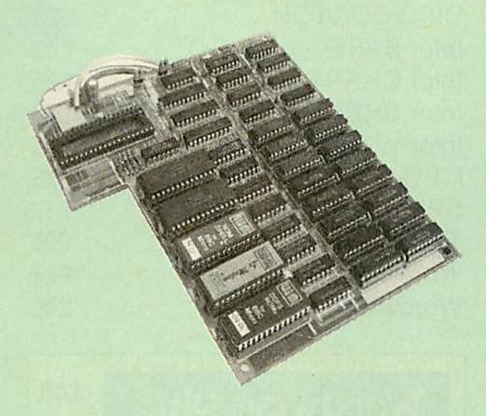
USER PORT SPLITTER UNIT



Gone are the days when you had to plug and unplug devices from the User Port. This extremely useful little device allows two units to be connected to the User Port simultaneously, and select between them simply by toggling a switch. This device is particularly useful for those people using Quest Mouse and the Watford Video Digitiser or any similar combination

Excellent Value at **£22** (carr £2)

ROM/RAM CARD



Watford Electronics announced the first ever commercial ROM board for the BBC micro, the Watford Electronics 13 ROM Socket Board 7 years ago. Following the success of this board, we have designed what probably represents the ultimate in expansion boards, the new Watford Electronics ROM/RAM board. This highly versatile and sophisticated board represents the latest in "2nd generation" sideways ROM technology for the BBC micro, designed to satisfy the serious BBC user.

- NO SOLDERING required to fit the board.
- NO User Port corruption (avoids problems with the mouse, modems, Eprom Programmers, etc.)
- Fully buffered for peace of mind.
- Compatible with BBC micros (not BBC+ or Master).
- Total number of ROMs increased from 4 to 8.
- Up to 8 banks of sideways RAM (dynamic).
- Option for 16k of battery backed CMOS RAM (CMOS RAM needs one ROM socket).
- Software Write protect for ALL RAM.
- Read protect for CMOS RAM (ALLEVIATES crashes during ROM development).
- Separate RAM write register (&FF30 to &FF3F).
- Automatic write to currently selected RAM socket for convenience.
- FREE utilities disc packed with software.
- Compatible with our DDFS board, 32k RAM Card, Delta Card, sideways ZIF, etc.
- Large printer buffer.
- UNIQUE fully implemented RAM FILING SYSTEM (similar to the popular Watford DFS).
- ROM to RAM load and save facilities.

The SFS (Silicon Filing System) can utilise up to the full 128k of RAM (with the SFS in any paged RAM) as a SILICON DISC. This behaves as a disc drive, with all the normal Watford DFS features (including OSWORD &7F for ROMSPELL, etc.) to provide an environment that looks like a disc but loads and saves MUCH faster.

The ROM-RAM Board plugs into the 6502 CPU socket. This leaves free all the existing ROM sockets, which can still be used normally.

Any ROM that can be plugged into the BBC micro's own ROM sockets may be used in the ROM-RAM Board.

The ROM-RAM Board is supplied with all ordered options fitted as standard. Upgrade kits (with full instructions) are available for all of the options, for later.

NTRODUCTORY PRICES:

- ROM/RAM card with 32k dynamic RAM £48
- ROM/RAM card with 64k dynamic RAM £65
- ROM/RAM card with a massive 128k dynamic RAM £109

(carriage on ROM-RAM Card £3)

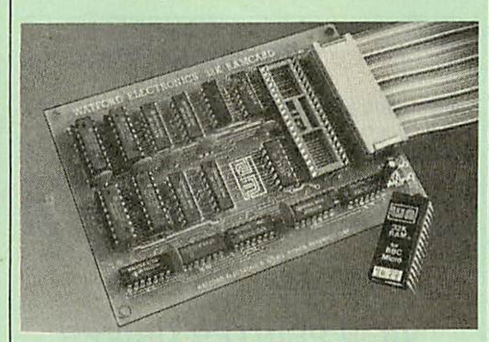
OPTIONAL EXTRAS:

- 16k plug-in Static RAM kit £9
- 16k Dynamic RAM for Upgrade £13
- Battery backup £3
- Read and Write protect switches ....£2 each

Complete ROM-RAM board
All options installed £115

P.S.
IS your existing ROM Board overflowing with ROMs? Do you need more Sideways RAM? Is your Board unreliable? Then upgrade to Watford, ROM/RAM Board and pay £5 less.

32K SHADOW RAM-Printer Buffer
Expansion Board



A MUST FOR WORD PROCESSING

Watford Electronics now brings you the latest state-of-the-art MEMORY EXPANSION BOARD for your BBC microcomputer. Don't throw away your BBC B for a BBC B Plus or BBC Master. Just plug the ribbon cable into the 6502 processor socket, and fit the compact board inside the computer. Immediately you will gain not 16k or even 20k, but a massive 32k of extra RAM!!!

- IMPROVE your WORD PROCESSING system, whether disc or cassette based. Don't wait for a slow printer – type in text while printing. TWO JOBS DONE SIMULTANEOUSLY and £100+ saved on a printer buffer.

- "VIEW" Wordprocessor users can now type in letters in 80 columns and have up to 28,000 bytes free – 5 times as much as normal.

- In WORDWISE (or WORDWISE-PLUS), preview in 80 columns with the full 24k of text in memory. This product is recommended as an ideal complement by Computer Concepts.

- Combine GOOD GRAPHICS and LONG PROGRAMS. Use the top 20k of the expansion RAM as the screen display memory, leaving all the standard BBC RAM free for programs. Benefit from MODE 0/1/2 graphics and 28k of program space.

- Use the FULL 32k or the bottom 12k of the expansion RAM as a PRINTER buffer for PARALLEL or SERIAL printers, sound channels, RS432 etc. Print large text files while running long graphics programs, and have all your buffer options available as well (*FX15,21,138, 145,ADVAL etc). Please note only a 12k printer buffer can be used with Wordwise or Wordwise-Plus, due to the way they are written.

- Unique facility to turn ROMs off and on again. Unlike all other ROM managers, this feature does not use 'unofficial' memory. Two bytes of normally user-inaccessible memory on the RAM card are used to ensure ROMs are disabled WHERE OTHER ROMS FAIL.

Only £59 (carr £3)
(Price includes a comprehensive manual and the ROM)

INCREDIBLE WORDPROCESSING DEAL

Watford's 32k SHADOW RAM CARD and Computer Concept's INTERWORD Wordprocessor package.

at Only **£89** (Carr £3)

CREDIT CARD 24 HOUR Ansaphone Hot Lines (0923) 50234 or 33383

Acorn Speech Synthesizer package complete, for the BBC B Microcomputer
Special Offer £18

BBC SOFTWARE'S Popular Educational Software

- Maths with a Story 1 (Disc). 4 primary level maths programs £11.25
- Maths with a Story 2 (Disc). 4 further maths programs. £11.25
- Picture Craft (Disc) 6-14 age group. Pack consists of flexible geometrical design & colouring programs. £17.00
- BONDING: Science (Disc) O-Level Chemistry program. £20.00
- ELECTROMAGNETIC SPECTRUM (8 Discs) O-Level program. £20.00
- ELECTRONICS IN ACTION (Disc) O-Level program. £19.95
- NEWTON & THE SPACE SHUTTLE (Disc) O-Level program. £20.00
- ECOLOGY (Disc) O-Level program. £20.00
- POLYMERS (Disc) O-Level program. £20.00
- Classification & Periodic Table O-Level. The suite is supplied with its own database of chemical elements which can be classified according to your own rule. £20.00
- FOOD & POPULATION (Disc) O-Level program. £20.00
- MICROTECHNOLOGY (Cassette) O-Level program. £11.25
- DEUTSCH DIREKT! (Disc & Audio Cassette) £19.95
- Modem Master (Disc) £11.25
- ADVANCED TELETEXT SYSTEM £8.65
- PERIOD TABLE SOFTWARE £20.00
- Astronomy – Primary (Disc) £12.00
- Computers at Work – Primary £17.35
- Introducing Geography 11-17 years £17.50
- Electric Fields 6-14 years £11.25
- Black Queen Contract Bridge £13.00
- Espana Viva – 3 Discs £19.95
- A Vous La France Disc £21.50

Educational Software

FUN SCHOOL 2 – Red:
Under 6 yrs – 8 programs on Discs, Shape Snap, Find the Mole, Teddy Count, Write a letter, Colour Train, Pick a Letter, Spell a Word & Teddy Bears Picnic. £13.00

FUN SCHOOL 2 – Green:
6-8 yrs – Eight programs on Disc, Number Train, Shopping, Maths Maze, Treasure Hunt, Bounce, Packing Caterpillar, 3 Number jump £13.25

FUN SCHOOL 2 – Blue:
Over 8 yrs – Eight programs on Disc, Build a Bridge, Passage of Guardians, Unicorn, Logic Doors, Souvenirs, Code Boxes, Mystery Machine & Escape. £13.50

Versatile BEEB SPEECH SYNTHESISER Unit



The Watford Speech Synthesiser is a very flexible speech synthesis unit based upon the powerful phonemes system. This system stores the building blocks of speech (called phonemes) and allows you to combine them quickly and easily to form virtually any word imaginable.

Supplied with an advanced ROM, you are provided with a 500 word dictionary to get you started. These can easily be added to by following the notes given in the comprehensive manual.

SPECIAL PRICE £32 (carr £3)

Continued→ → → → → → → → → →

VIEW 3.0 ROM £45

VIEW PROFESSIONAL £50

VIEWSHEET (Acornsoft) £36

VIEWSTORE £36

VIEWSPELL with 80 track disc £25

VIEWPLOT Disc £20
(Please specify for Master 128 or Compact)

VIEW-INDEX £12

OVERVIEW packs 1 & 2 £65

Watford's own Sophisticated VIEW PRINTER DRIVERS

Epson FX80 & Kaga KP (Disc)	£8
Juki & Brother HR15 (Disc)	£8

OFFICE MASTER



CASHBOOK – A complete "Stand Alone" accounting software package for the cash based sole trader/partnership business. It is designed to replace your existing cashbook system and will provide you with a computerised system complete to trial balance.

FINAL ACCOUNTS – Will take data prepared by the Cashbook module and produce a complete set of accounts as following: Trial Balance with inbuilt rounding routine; Notes to the accounts; VAT Summary; Profit & Loss A/C; Balance Sheet.

MAILIST – A very versatile program. Enables you to keep records of names and addresses and then print, examine, sort and find them, all with special selection techniques.

EASILEDGER – A management aid software tool designed to run alongside an existing accounting system. Essentially a Debit/Credit ledger system which can handle sales, purchase and nominal ledger routines to provide instant management information.

INVOICES & STATEMENTS – Greatly reduces the time and cost of preparing Invoices and Statements by storing essential information like customer names, addresses and account numbers. Has VAT routines and footer messages facility.

STOCK CONTROL – Allows you to enter stock received, stock out, summary of stock items and current holdings together with details of total cost, total stock to minimum level, units in stock ordering, quantity and supplier detail.

All this for only **£21** (Disc)

OFFICE MATE



- DATABASE
- BEEBCALC SPREADSHEET
- BEEBPLOT GRAPHICS

DATABASE – Set up a computerised card index system with powerful search facilities.

SPREADSHEET – Offers many calculation and editing features

BEEBPLOT – Provides visual representation from Spreadsheet data.

OFFICE MATE Only £10 (Disc)

MINI OFFICE II

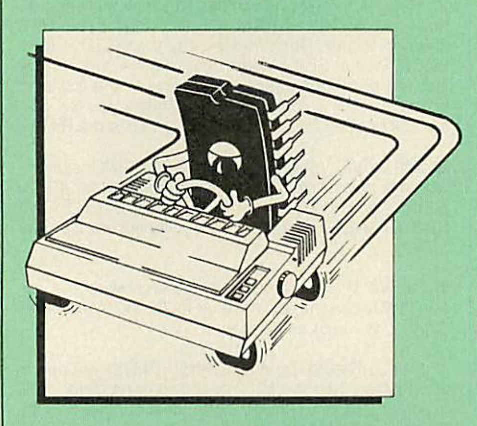
DISC Version for BBC B & B+	£14.00
DISC Version for BBC Master	£16.00
DISC Version for the Compact	£18.00

(When ordering please specify for which Micro & 40 or 80 track Disc)

Advanced Computer Products

Advanced Disc Toolkit	£28
Advanced Disc Investigator	£24
Advanced 1770 DFS BBC	£27
Advanced 1770 DFS Master	£28
Advanced File Manager	£24
Advanced Control Panel	£28

VIEW PRINTER DRIVER ROM



View is a powerful word processor, but until now has seriously lacked in terms of printer support. With the launch of our Printer Driver ROM, which includes an extremely powerful and easy to use Printer Driver Generator, View users can find themselves in the realms of advanced word processing at only a small outlay.

The VPD extends View's printer command with a series of mnemonic commands. All standard highlight sequences are also supported. A large range of printers are supported by drivers contained within the ROM (the drivers can be downloaded and customised). Printers supported include: Epson's MX, RX, FX, LX, JX80 range, HI80, KP810/910, PW1080, JP101, HR15, M1009, GLP, Panasonic KX-P1081/2, JUKI 6100, etc.

Other printers are readily supported by defining a Printer Driver using the built-in Printer Driver Generator. The features mentioned below are available to both the built in Printer Drivers and user defined drivers (assuming the printer supports the features).

NLQ control, Underline, Bold, Proportional Spacing, Microspacing, Italic, Superscript, Subscript, Condensed, Enlarged, Double Strike, Set lines per inch numerically (e.g. LPI 6), Set characters per inch numerically (e.g. CPI 5), Select printer font, Select printer ribbon colour, Translation sequences, Emulation of BBC Character Set, Simple numeric expressions for certain operations, Full printer setup, Send control codes, Print prompt on screen, Redifinable Pad character, Pause for key press, Prompt to change daisywheel, and Execute ★ command when printing.

Other features include a very powerful on-screen preview, with bold, italic, underline, super/subscript, enlarged highlights, and a special printer driver to allow memory-based text to be previewed by View 1.4. Of course, View 1.4, 2.1 and 3.0 are all supported, as is Shadow RAM and 6502 Second Processors. The BBC B series and Master series of micros are supported. A comprehensive manual is supplied. All in all, a very professional product for the discerning user who wants power at their finger tips. (Write in for a detailed leaflet).

Price: Only £33

COMPUTER CONCEPT'S ROMS

COMMUNICATOR	£49
DISC DOCTOR	£28
Inter BASE	£49
Inter CHART	£25
Inter SHEET	£37
Inter WORD	£36
MEGA-3 ROM	£76
SPELL MASTER	£42
TERMI	£25
Wordwise	£24
Wordwise Plus	£40

Wordwise plus £40

We are giving away absolutely **FREE,** the superb Word-Aid ROM worth £24, with every WORDWISE PLUS package bought from us.

Word-Aid

The most comprehensive utilities ROM for Wordwise-Plus

Extend the power of your Wordwise Plus word processor with this most advanced ROM from Watford. By utilising the powerful Wordwise Plus programming language, WordAid provides a whole host of extra features, all accessed via a special new menu option. This ROM has been personally approved by Mr Charles Moir, the author of WORDWISE PLUS.

- Alphabetical sorting of names and addresses.
- Text transfer options.
- Chapter marker.
- Epson printer codes function key option.
- Search and display in preview mode.
- Embedded command removal.
- Print Multiple copies of a document.
- Multiple file options for print and preview.
- Address finder.
- Label printer.
- Mail-merger.
- Number/delete/renumber.
- Clear test-segment area.
- BBC B, B+ and Master compatible.

Only £24

(N.B. Word Aid requires a Disc interface in your Micro)

BOOK

The Complete Mouse User Guide to BBC Micro

This manual has been written to reveal the secrets of the mouse. It explains all the principles required by the hardware and associated software, and also example listings for inclusion into custom programs. The manual first details the basic principles of the mouse and a simple program which uses these principles. This information should be adequate for most applications. However, it is possible to improve the performance of the mouse by expanding on the principles already used in the software. This is again fully explained and an example program given.

It is possible to gain a full understanding of the mouse from this manual. For those not interested in exactly how the mouse functions, complete example programs are also included. These may be typed directly into the micro, without the need for any understanding of the hardware or software involved, enabling the mouse to be used for custom applications.

Price £5.95 (No VAT)

Example programs on Disc £4.95

BOOKS (No VAT on Books)

15 Hr Wordprocessing BBC/View	£5.95
15 Hr Wordprocessing BBC/WW & WW+	£5.95
30 Hour BASIC (BBC Micro)	£12.95
Advanced User Guide for BBC	**£10.95**
Amiga Machine Lang. Guide	£19.95
Archimedes 1st Step – Beginners Guide	£9.95
Archimedes Assembly Language	£14.95
Archimedes Operating System	£14.95
Archimedes Risc-Os Programmers Reference	£79.00
Assembly Language Prog. for the BBC	£10.95
Assembly Language Quick Ref.	£21.95
BASIC 2 – User Guide	£2
Basic V – A Dabhand Guide	£9.95
BBC Basic Guide (Archimedes)	£19.95
BBC Computer Handbook – The Complete	**£14.95**
BBC – Mastering Assembly Code	£8.95
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BCPL User Guide	£14
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C Programming Lang. 2nd Edition	£24.95
COMAL – Introduction to	£9.50
Deutsch Direkt! (Book only)	£5.95
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File Handling on BBC Micro	£8.50
FORTH on the BBC Micro	£9.95
Hackers Handbook – New	£9.95
Introduction to COMAL	£9.50
Inside Information, Computers & Coms.	£9.95
ISO-PASCAL Reference Manual	£9.95
Mysteries of DISC DRIVES and DFS REVEALED	**£5.95**
Mastering Assembly Code	£8.95
Mastering Interpreters & Compilers	£14.95
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The Epson FX-KAGA PRINTER Commands REVEALED	**£5.95**
The Software Business	£5.50
Understanding Interword – A Beginners Guide	£6.50
View 3.0 User Guide	£10
View Guide (View 2.1)	£5.00
Viewsheet & Viewstore Dabhand Guide	£12.95
VIEW Dabhand Guide	£12.95
Viewsheet User Guide	£10
Viewstore User Guide	£10
Wordwise + A User Guide	£10.95
Z88 – A Dabhand Guide	£14.95
Z88 Computing	£9.95
Z88 Magic	£14.95
Z88 Using Your	£9.95

Carriage on Books vary between £1 to £3.50, depending on their weight.

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1-2-3 Command Language	£19.95
1-2-3 Mastering Release 3	£22.95
1-2-3 Mastering – 2nd Ed.	£20.95
1-2-3 Special Edition (QUE) – Using	£22.95
1-2-3 Using – Rel. 3	£22.95
8086/8088 Assembly Language Prog.	£13.50
8086/8088 Programming the	£17.95
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Agenda – Using	£21.95
Aldus PageMaker – Using	£21.45
Amstrad Basic 2 Manuals	£9.95
Amstrad Technical Manual for 1640	£19.95
Amstrad PC Programmers Ref Guide	£7.50
Amstrad PC1512-1640 Step by Step – Using	£9.95
Amstrad PC 1512 PC User Guide – 2nd Ed	£10.95
Autocad – Mastering Through Rel. 10	£28.95
Autocad – Using Release 10	£26.95
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C Programming Library – The	£24.95
dBase III – Mastering	£21.95
dBase III Plus – Complete Reference	£19.95
dBase III Plus – Mastering	£21.95
dBase III Plus Handbook 2nd Edition	£20.95
dBase III Plus – tips, tricks and traps (QUE)	£20.45
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dBase III Plus – Quick Prog. Guide	£8.95
dBase Instant Reference (III & III+)	£10.95
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DOS Power Tools (includes a disk)	£39.95
DOS Plus Manual/Amstrad PC	£9.95
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Lotus 1-2-3 Desktop Companion Soft/B	£24.95
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Norton Utilities – Inside the	£19.10
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Novell Network – The ABC of	£21.95
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PageMaker on IBM PC – Using	£22.95
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Quattro – Mastering	£21.95
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Turbo Pascal – Complete Reference Ver 5	£24.95
Turbo Pascal Complete Ver. 4.0	£21.45
Turbo Pascal Disc Tutor	£36.25
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Wordperfect Made Easy	£15.95
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WordStar Release 5.0 – Using	£19.95
WordStar – Quick program Ref. Guide	£8.95
Xerox Ventura Publishing – Inside	£27.95

THE COMPLETE BBC COMPUTER USER HANDBOOK

"Why has no-one written a book like this before? It's long overdue".

If you own a BBC-B, BBC B+, Electron, Master 128, Master Compact or Archimedes then this book is for you. It shows you how to get the most from your computer, and how to make the computer work for you. Although some sections are machine specific, most of the information, programs, hints and good solid experience are for the whole range of BBC machines. The general style and level means that both beginner and expert will feel satisfied with the quality and quantity of the material.

GENERAL – Uses and abuses of computers.

HARDWARE – How to design your own work station. Hardware additions (disc drives, ROMs, printers, 2nd processors, etc). DIY alterations.

HARDWARE RUNNING BBC-BASIC – All BBC machines are described with their differences. Compatibility between the various BBC machines. Networks. The Archimedes and its advantages.

GETTING ORGANISED – So that you keep track of your programs and control of your software. Setting up for easier programming sessions.

NEAT PROGRAMMING – Good style. Writing structured programs. Getting the best from BBC-BASIC, Graphics and screen displays. Speeding up programs. Saving space.

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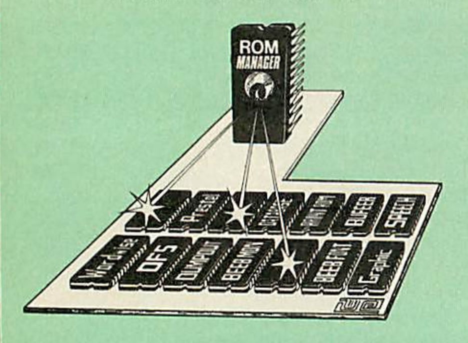
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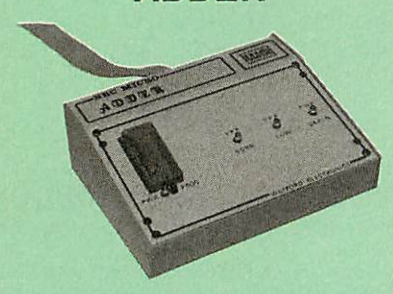
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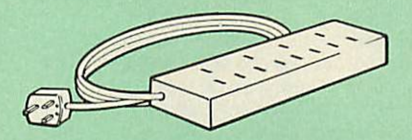
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$$= \frac{1}{2\pi i}\left[\sum_{v=0}^{\infty}(z-z_0)^v \cdot \oint_{K_1}\frac{f(\zeta)}{(\zeta-z_0)^{v+1}}d\zeta - \sum_{v=1}^{\infty}\frac{1}{(z-z_0)^v}\cdot\oint_{K_2} f(\zeta)(z-\zeta)^{v-1}d\zeta\right]$$

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Trying to make your computer act intelligently is more a problem of deciding just what intelligence really is. **WILLIAM BAINS** goes in search of the truth

Zap! Blam! I am playing *Ygdrasil*. I have outrun Loki, but a group of giant killer ants are coming over the horizon. Luckily I have found that the fearsome Guardian of the Underworld is a Brontosaurus and herbivorous. I can dodge through its nest into the safety of...

Of course, you have never played *Ygdrasil*. Not surprising, as I just made it up. Making up games like that is fun but playing them is rather dull.

It is either the quickness of the eye and hand (and the knowledge that the programmer has tweaked the code to allow you to even get a look in) or memorising endless lists of twists and turns as you explore a world (again knowing the programmer has been there before you).

Playing the game is as exciting as watching the grass grow. How much more fun to be the programmer, to launch your creation into the world and watch it perform, beating all comers.

Of course, the odds are stacked. When it comes to memorising huge lists of garbage or responding to keys in microseconds, your Arc or Beeb has the edge over anyone merely human. Playing *Ygdrasil*, *Pacman* or whatever requires little intelligence from you and none from the computer.

The real test of programming skill is to get the machine to challenge you to something that needs 'skills', not just Risc chips. But that implies intelligence and all those incomprehensible AI programs. Surely beyond the bounds of BBC Basic?

Not so. The most difficult part of Artificial Intelligence is deciding what intelligence actually is. Once that vast philosophical problem has been overcome (or ignored or sidestepped) getting your Basic to play chess is relatively simple.

Until recently, the ability to play chess was taken as sure proof of intelligence. So chess was one of the early targets of research into Artificial Intelligence and scientists now know a lot about how computers can play games.

To be fair, games theory itself underlies a lot of common problems (such as how to end the arms race) and games have a lot in common with real life problems. So this is not just an exercise in applied indolence (or AI for short).

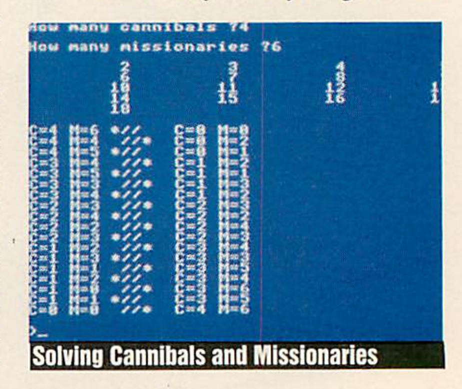
The most popular approach to designing a game-playing program is known as search. But chess is a rather daunting problem to start with, so AI researchers have developed a gamut of other games, starting from the ludicrously simple, to break research projects in gently. One of the most basic of these is the age-old Cannibals and Missionaries problem.

Cannibals and missionaries

Cannibals and missionaries is about as simple as a game can be and still be a challenge to, say, a reasonably bright mouse. Two cannibals and two missionaries have to cross a river using a boat that only holds two people. Only missionaries can row. If the cannibals outnumber the missionaries on either bank, they eat them. How do the missionaries ferry the cannibals across?

Very small, very simple, but needs a bit of thought. We can generalize it to the C cannibals and M missionaries problem. How long does it take you to solve for M=2, C=2? For M=3, C=2? Try it. It will give you a benchmark for your program.

There are two keys to search theory. The first is how to represent your game. We



Solving Cannibals and Missionaries

BRAIN

need a simple way of representing the current status of the game, no matter what that status is. We must keep in all the essential information but keep out too much rubbish.

In this game, the problem is to find a series of moves, so our representation has to tell us the number of cannibals and missionaries on each side of the river, which side of the river the boat is on and what was the game position we just came from (so we can track where we have been) – six numbers in all. We shall call this the current position. We can show how you get from one position to another by drawing a diagram called a game tree (figure 1).

The second key is how to get the computer to search the tree for the bit we want. There are two approaches. 'Depth-First' search looks at a position, and asks: what position can we derive from it? Then it looks at that one and so on until it reaches the bottom of the tree – the point where the missionaries are eaten (lose) or the motley crew crosses (win).

If it's a win, the program stops. If you have lost then you backtrack to the previous position and try another potential move.

This is a pretty repetitive endeavour. You could do it iteratively, with masses of nested FOR loops but it is neater to do it recursively. Each new position can be made by making just one move on the old one.

This is *Camish1* in the yellow pages. Actually, much of the program is I/O and prettying up.

So we have got our representation and our search strategy. How well does it perform? On C=2, M=2 it is blindingly fast. Faster than you, I'll bet. Now try C=1, M=3 – not bad. M=4, C=2? Now that causes a bit of a problem.

The problem is the program is not very clever. Cannibals and Missionaries is not like, say noughts and crosses, in which there are only nine moves to each game. *Camish1* can go on searching forever and if you set along the wrong path it will. Depth-First search is quick and needs little memory but is prone to problems of this sort.

It is no use saying there is a solution that only takes eight moves if the line the search is taking happens to go off another way.

The alternative is 'Breadth-First' search. This is systematic but dull. It involves taking all the first moves and only when it has

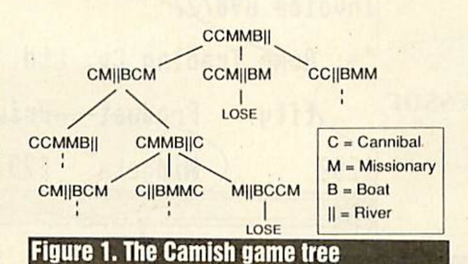


Figure 1. The Camish game tree

checked them does it go for all possible second moves, then all third moves.

While this is bound to discover the shortest winning strategy it needs the whole game tree in memory at once and it requires you to search an awful lot of paths which will ultimately turn out useless. Breadth-First searching is the bank manager to Depth-First's used car salesman.

Nevertheless, it doesn't need recursion – a relief to some. *Camish2* is the Breadth-First version. The game tree is held as in a 1D array in the program it is meant to show what is linked with what, not how it is arranged to space.

Try *Camish2*. Slow, isn't it? But it will get there. Try it on C=5 for M=5, 6 and 7. Which are possible?

No, on second thoughts, don't bother. *Camish2* is not rather slow, it is very slow. We have run into the combinatorial explosion. How many positions must we search to solve a C=5, M=7 problem? Well, there we need to make at least five trips to take five cannibals across, and four to bring the boat back, so our tree must be nine layers deep at least.

At each position we could move one missionary, one missionary and one cannibal or two missionaries so that is three moves to be considered for each position in each layer. There are three possible first moves, each (nearly) giving rise to three second moves. After 20 moves we have five billion positions to contend with!

Pruning

Of course, much of this is wasted effort. If the first move was to move one cannibal and one missionary across the river, moving them straight back again is silly. But this argument is itself using the very intelligence we are trying to identify. At the moment our search is systematic but unintelligent (*Camish1* was unsystematic and unintelligent). We must give it a bit more insight. One way to do this is by pruning.

There are lots of ways of doing this. An obvious one is to ignore any new positions which are copies of old ones.

Camish2A provides a few lines to insert into *Camish2* to turn it into *Camish3*. Now try M=7, C=5. Not so bad. It still slows down since it checks back over a growing list of previous positions. But at least it finishes in less than an evening.

The great french bistro game

So that's search. This has been used in those bits of AI that are actually of some use. Search methods can find the simplest method – the simplest path through a factory for a robot, the shortest route through a mathematical proof for a logic program, the best plan for a one-way system.

Consequently these applications are now considered nothing to do with AI – if it is just about planning and robots, it is not really intelligent, is it?

When AI search programs were perfected in the late 1950s, everyone agreed that this, after all, was not what they meant by intelligence.

One problem is that *Camish* is hardly an exciting game. What about something with bite? Chess? No, we are not quite ready for that, but something combative certainly. Something that pits man against machine, so we can test directly if the thing is intelligent. How about *Jet*?

Jet is a thin version of draughts. (Yes, I invented this one too). It is an ideal game to be played on the gingham tablecloths of French bistros, using sugar cubes as pieces (ideally, when more than slightly drunk, but that needn't be incorporated in the program at the moment).

The rules are simple. You play on one line of the cloth. At each turn, you move one of the sugar cubes left or right one place. If it lands on top of another cube, that one is obliterated. You have equal numbers of cubes at the start, arranged at random. The player with any sugar cubes left at the end wins.

The representation is simple – a line of numbers representing the board and the pieces in it. Again, we will generate a tree of all possible moves, using recursion to generate each level.

DRAIN

To avoid the sort of nonsense that *Camish1* landed up in we will do a drastic prune: chop off any positions more than a certain number away from where we are now. There is just one small problem left.

Minimax

Two people play *Jet*. Now, when we were playing *Camish* it was pretty obvious what was a win and what a lose. But with *Jet*, what is a good result for me (the computer) is a bad one for you (the player) and vice versa. So we must decide whether a move is good or bad depending on who is making it as well as what it is.

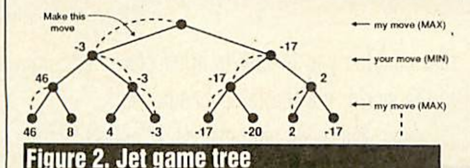


Figure 2. Jet game tree

Look at the game tree (figure 2). At the bottom are various 'goodness' values – how near we are to my (the computer's) goal. Clearly, if I am making a move, I will make one which leads to the best position for me. If it's your move, you will try to worsen my position.

What if I have to choose, and then you choose? Well, I know you will choose the worst move you can find. So I must arrange that none of the moves you find are too bad for me. I say 'Hum, move 5 allows him to get a -17, not too good. But move 3 only allows a -3. I'll take move 3'.

In programming terms, this means the value of each of my positions is the maximum of the value of each of the positions below it on the graph, and the value of each of your positions is the minimum. Searching the tree becomes a fairly simple exercise in searching a set of next positions which have maximum or minimum 'goodness'. *Jet* does just that.

Alas, this is a rather slow program. Each time it explores a move, it has to search and copy an array. It would be much faster to list the positions of the pieces that existed, rather than of all the (mostly empty) squares. But not so obvious.

'Minimax' searches are still the basis of many games-playing programs. As with *Camish*, you can prune the tree quite a lot. As it stands, *Jet* suffers from a bit of a combinatorial explosion but with a half-bottle of *vin de table* inside you it can keep you entertained until the next course arrives.

Heuristics

Search methods can get you a reasonable checkers game but fail at chess because of the number of moves. So, come about 1965, the goal-posts were moved and it was decreed that merely solving logical puzzles was not real intelligence.

It had to be something more interesting, like chess. *Jet* just searches all the possible options, ranks them and executes the highest ranking. Where is the strategic thinking, the cumulative experience? Hardly a chess Master! (Actually, a chess Master who did not look at all the options, rank them and do the best would look pretty silly).

What we need is to incorporate some element of intuition into the process. What we need is an heuristic.

An 'heuristic' is a rule of thumb – a rule that's found to work rather than one worked out from first principles. Like 'don't make welsh rarebit in an electric toaster' (I learnt that from experience).

Most of our daily lives are based around such rules of thumb. If it is dark in the morning, we curse the lousy weather, although we could theoretically be in the middle of a total eclipse, have gone blind, or accidently have slept through the last trump and been left behind.

Surely it is some combination of both heuristics and logic that is the mark of true intelligence.

Take a look at *Camish1* and *Jet* again. There are heuristics lurking there keeping an eye on things. Look at lines 430-450 of *Jet*, for example.

They say what to do if two moves are equal. Our Minimax algorithm tells us what to do only if one move is better than another. We could just pick the first we come across but that does not conform to the point of the game – to annihilate your opponent. Look at figure 3.

If we chose move 2 the first time, why not every time? This would result in our cube wandering away off the edge of the table. We can never search the entire tree because it is infinite. We have to prune it somewhere. So we have given our searching program a little heuristic nudge which, all other things being equal, guides our cubes together into a clump.

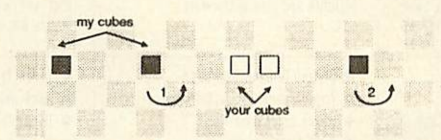
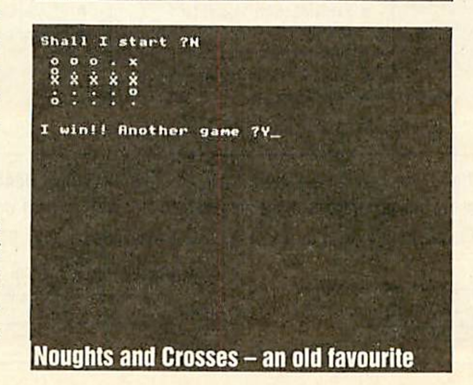


Figure 3. Possible 'equal' best moves



Noughts and Crosses – an old favourite

Camish1 is even more saturated with these. Here the logical part of the search is sketchier, so we must guide it with a firmer hand. Try swopping lines 310 and 340, and running the standard C=2, M=2 problem. The program gets itself lost in an endless series of cyclic ferryrides.

But all we have done is swop one sort of completely systematic search for another. Surely, if you are going to turn over pebbles on the beach, whether you start with the large ones or the small ones is irrelevant? Not so (especially if you have a bad back). The *Camish* beach is littered with 50kg boulders. The order of the search in *Camish1* works because it is the right order. The heuristic here is not a line of code but the very structure of the program.

However, here we stray from search and into knowledge engineering. One of the problems of putting knowledge of any kind into computers is finding out what the knowledge is. This is one reason why the representation of your game is so important. A complete representation contains all the knowledge the computer might need. The knowledge in *Jet* is fairly complete but not all of it is present in the Minimax rules. Lines 430-450 are a default to guide us when the rules break down.

This is a common feature of many AI programs. We assume the meat in a butcher's shop is for sale although the butcher rarely has a sign up to tell us. This can lead to ludicrous misunderstandings if we wander onto a film set by accident or if we go in after the butcher has shut (and hence the default is no longer valid).

Knowledge can be hidden in other ways. Most human discourse contains a vast amount of 'Tacit' knowledge, knowledge which is never stated in formal terms. What, for example, is a mess? Try to think up a rigorous definition. Well, my Basic code is – Basic is defined explicitly in the User Guide but good programming practice is not defined, except by laborious examples from which we get a 'feel' for it.

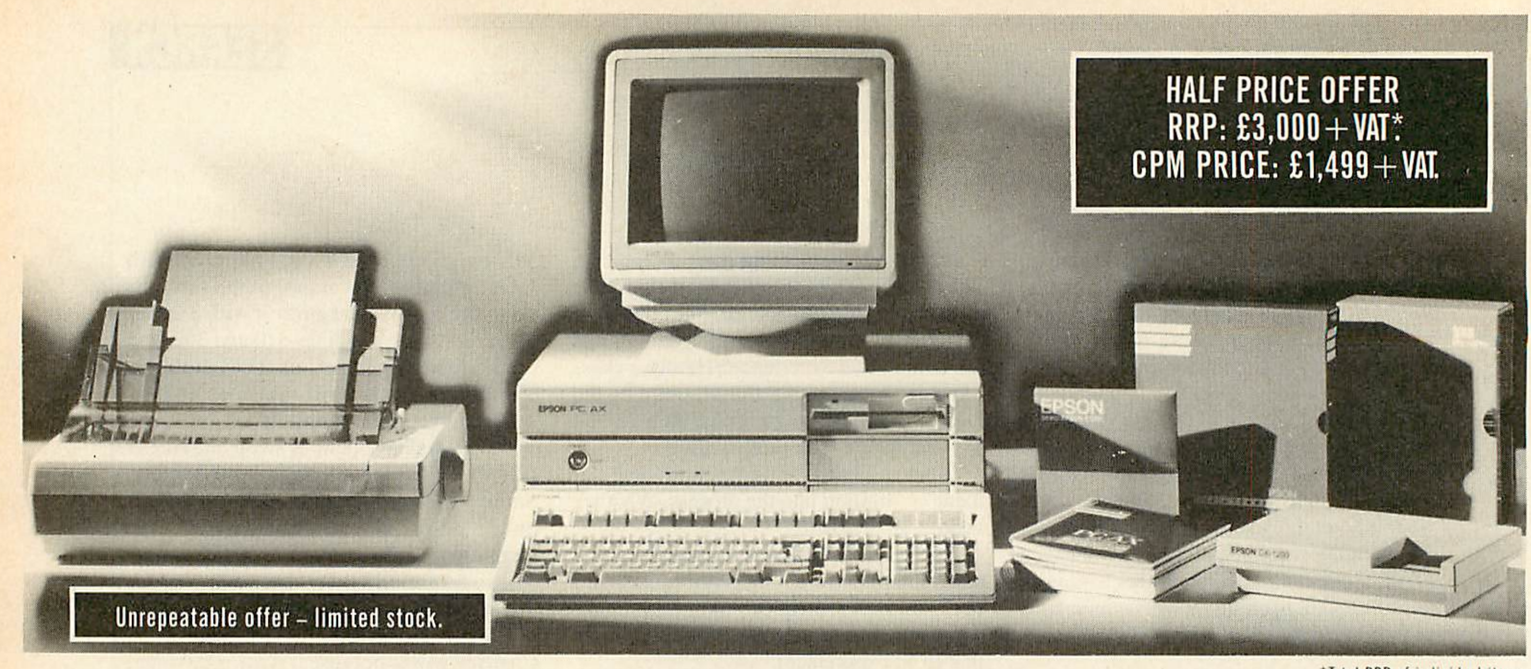
That's fine for us but how are we to squeeze it into logical rules which can be translated into Basic?

One route is to do just that – to use a set of rules rather than a program. Rules-based systems are a bit tricky in Basic but the last game gives a flavour.

Noughts and crosses is an old favourite. The game tree is vast but finite. Because the board is symmetric we can actually cut down the tree by clever pruning.

Indeed, it is so simple, you could build a computer from Meccano to play it. Someone at MIT has!

It's too easy. Let's make it a bit harder by expanding the board to 5x5. That means (not counting symmetry considerations) a game tree with 1.55x10.25 positions on it – this could take a while!



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Without some pruning it would take forever. Even with pruning it's slow but using a rule-based system it can be as fast as you.

Tictac is the implementation and it has an innovation on the other programs: it has DATA statements. These are the rules base. In rules-based programs written in Lisp, the rules look more like rules, with IF and THEN in them. But lines 840-950 are rules for all that, their format itself being defined by a rule (line 840) and the 'all other things being equal' rule is there in line 850.

The program searches for matches of the current board position with its rules base which identifies winning positions that could come out of the current board and hence where potential winning lines cross most often, and whacks a 0 down there. I have found it quite unbeatable.

Because the rules are separate from the program, you can alter and get a new game. The last bit of code, *Tictac1a*, converts *Tictac* to *Square*. The object is to make not a line across the board but an eight-piece square of your letter.

We could extend the same idea to checkers or even chess. Chess programs use a mix of exhaustive search, heuristic rules and more systematic, logical rules like those in *Tictac* to play up to Master level. They are as much proof as you would need that intelligence must be captured by a mix of formal rules and heuristics and that just one or the other will not do.

The same mix is used in expert systems, where a vast database of rules is searched for patterns which match the data available. They can do as well as a consultant medic at diagnosing infectious internal disease and have actually done better than professional geologists in predicting ore formations. In some respects *Tictac* is a small expert system, with an inference engine (the program) to drive the rules and a rules base (the DATA statements) to contain the knowledge.

NLP

So are computers intelligent? By the criteria of the 1960s they clearly can be, at least in limited domains. This leads to the 'but they cannot...' argument: Prospector might know all there is to know about Molybdenum but it cannot play chess. The answer is simply to put all the expert systems and games programs onto one computer. And so the 1960s criteria have been dropped in favour of three others.

The first is in language – intelligent organisms can understand Natural Language. This has given rise to a range of 'Natural Language Processing' systems which are getting as good at their thing as chess programs are at chess. They, too, started off with search-like systems but these proved tiresomely inflexible and have been augmented by other methods. The Natural Language goalposts are showing signs of itchy feet, and might move again soon.

The second area is vision. Visual recognition is something which we do incredibly well and conventional computers do astonishingly badly. Put one of your left-over Christmas cards in front of a conventional vision system and it might eventually identify Father Christmas as a post-box.

In part this is tacit knowledge appearing again (remember all those old cartoons, with aliens addressing post-boxes sternly saying 'Take me to your leader' – the aliens lacked the tacit knowledge. A picture, even a grotty mono TV picture, is worth a thousand words, and correspondingly worth about 10K! When any one bit might be crucial, that's a lot of information to process. What any one bit might mean depends on hundreds of other bits around it. Combinatorial explosion blows in with a vengence. Conventional computers are just not meant for that sort of computing.

Our eyes manage it because they are massively parallel computers. There are millions of nerve cells firing away at once analysing these words for you. So, why not build a computer the same way? They did, and it works! This is the basis of neural net computing, which is to pattern recognition what your BBC Basic is (now) to checkers. However it is a million conceptual miles away from rules bases and search, so we will leave it for another day.

Let's turn to the last definition: intelligent systems are not defined by what they do but by what they learn. So far everything we have done has been to tell the computer exactly what to do. We have never started with tabula rasa and said 'There you are, Albert, see what you make of that'. Computer learning systems have not been very successful but a new approach to computer learning is catching up fast.

The rules base of *Tictac* is simply a lot of numbers. Computers are very good at manipulating numbers. So could it generate its own rules base? Could it, in short, teach itself to play Tic-Tac-Toe?

The method is the use of genetic algorithms. They are simple but quite new, as no-one has taken this sort of apparently random learning seriously before, but recent research shows they can be a stunningly good way to get computers to learn – not surprising as they are the algorithms that our own nervous systems use when we learn to see, talk and walk.

Genetic Algorithms work, in a crude summary, by generating a lot of possible rules and then allowing those that are 'active' when the program 'wins' to flourish, while those which are active when the program 'loses' die off.

In *Tictac*, determining winning and losing is easy, and generating rules is easy (they are, after all, just numbers). So how about a program where you make a game at the start and then get the computer to guess what the rules are? This is still search, although one level more abstract than *Camish* and *Jet*.



And if learning complex tasks is not the mark of intelligence, a lot of Universities, and a vast number of schools heading for a nasty shock.

TALKING TERMS

Recognising human instructions is one thorny problem at the root of Artificial Intelligence. GRAHAM KENDALL, though, has no problem making himself understood



A parser is a piece of software that accepts input, validates the words and passes control to various routines that act upon your instructions.. An example would be the instruction GET BOOK in an adventure game. The parser would ensure it understood the two words and then pass control to a routine that dealt with the verb 'get'. It would be up to the GET routine to make sure the book was available and that it was an object that could be got.

Parsers are most frequently seen in adventure games but they are also used in other applications and really form the basis of one approach to Artificial Intelligence.

Instead of the user being led through a series of menus, a parser allows the user to talk to the computer in English. This, of course, is a sensible move. If you are creating an AI application you want to make it seem as intelligent as possible. What better way than being able to talk to the computer as you would another human?

This article will demonstrate some of the techniques you can use when writing your own parser.

In the early days, home computer parsers were primitive pieces of software. They only allowed two words to be input and insisted that the first word was a verb and the second word was a noun. Adhering to these rules you were allowed to enter things like GET BOOK or FIGHT TROLL.

But they did their job and the people who played adventure games were happy with them. In fact so successful was this formula that even with today's sophisticated parsers, a lot of adventurers still use this two word format to instruct the computer what to do.

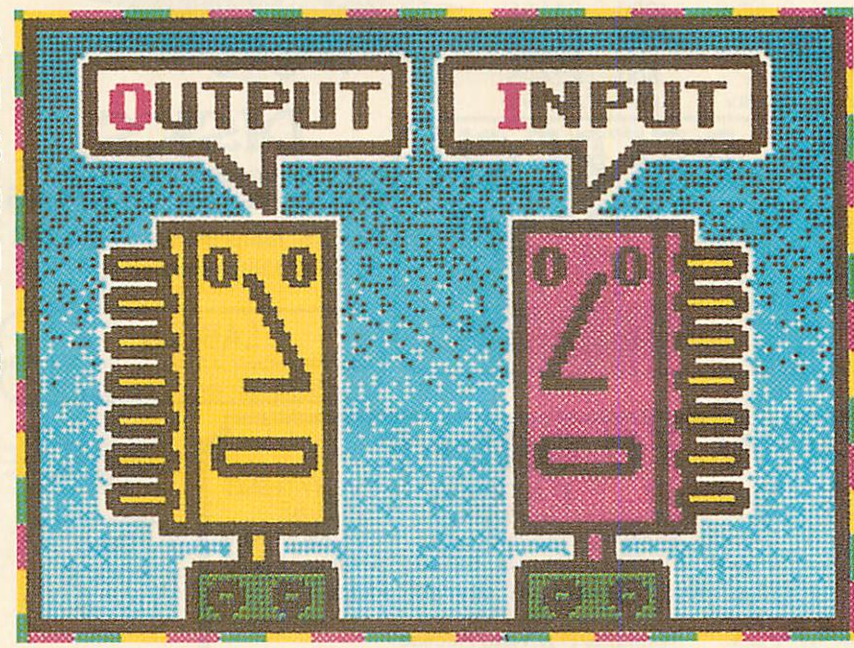
A simple parser along these lines is given as listing 1 in the yellow pages. It will accept one or two words as input and will validate that the first word is a verb and the second word, if present, is a noun.

The program is easy to follow but some points should make it even clearer.

The verbs recognised by the program are held in the DATA statement. The numbers held after each verb are used to decide which verb subroutine to call. There will obviously be one subroutine for each verb, although in this program the verbs all point to the same subroutine as we are only presenting a demonstration program.

By using the same number for different verbs we can give the user a larger vocabulary. For example the words 'get' and 'take'

Parsers really form the basis of one approach to Artificial Intelligence



could both be allowable verbs, but if they were followed by the same subroutine number then they would call the same subroutine.

The nouns recognised by the program are also held in DATA statements. The (nearly) boolean variables verb_ind% and noun_indIND% indicate whether a word is recognised or not. In addition, noun_ind% can take the value -2 to indicate no noun has been input.

Now we have our basic parser we can think about extending it. It would be nice to allow more than a two word input. This would allow input such as LAUNCH THE SPACECRAFT or GET BOOK AND PIPE.

This constitutes two important advances. First the English is more natural. Saying LAUNCH THE SPACECRAFT is a lot more natural than LAUNCH SPACECRAFT. By allowing extra words the user can say things as they would in real life. In an adventure game or AI application this will allow the program to appear less disjointed as the user will not have to consider, as carefully, what he/she is saying.

The second enhancement allows us to pass two nouns to the same verb. So, instead of GET BOOK followed by GET PIPE we can say GET BOOK AND PIPE. Again, this is a more natural way of saying things and will get the user more involved.

This is even more important when attempting to create an AI application. If possible we want the user to think he/she is talking to another human being. That illusion will never be created if the user has to consider every key depression.

Listing 2 implements all this. It discards words that the user may have typed which we are not interested in and it allows for more than one noun.

First it checks if any nouns have been input. The variable ctr% contains the number of nouns detected. Any that are found are validated with PROCvalidnoun.

Like the last program, control is passed to various subroutines depending on the number associated with the verb. Again, for this demonstration, the same subroutine is called for each verb. This will only display that the subroutine has been called, the calling subroutine number and the nouns that are being passed to it.

The variables, no_verbs%, no-nouns% and no_elims% contains the number of words contained in the DATA statement (and read into arrays, verbs$, nouns$ and elims$) so that if words are added or deleted only minor program amendments have to be made.

PROCvalidinput validates the input. It does this by searching for a space and putting the characters to the left of this space into the variable inp_verb$.

If no space is found, the program assumes that only a verb has been input. In this case the input string is placed into inp_verb$ and the procedure is terminated.

If more than one word has been input, the remaining input is split at the spaces and each word is placed into successive elements of inp_nouns$.

In addition, once a word has been extracted from the input string it is passed to PROCelim which checks to see if it is a word that can be eliminated. If it is, ctr% is reduced by 1 which effectively deletes it from inp_noun$.

PROCvalidverb checks the verb is valid. It does this by checking the string inp_verb$ against the verbs held in the array verb$. If a match is found, the variable sub_rout% is set to verb$(n,2). This is used to decide which subroutine to call.

PROCvalidnoun validates each noun. As more than one noun can be input, the processing is a little more complicated than the verb validation routines but essentially it does the same thing.

Lines 680 to 740 contain PROCelim. This procedure takes in a word as a parameter and checks if the word can be eliminated. If it can, an indicator is set. This indicator can be tested by the calling procedure.

The above program, when run, gives the impression of being quite a sophisticated parser but it is quite economical of code.

The final parser we are going to look at takes a major step forward. There are two enhancements. It not only allows multiple verbs but also allows the user to dictate the order in which tasks will be carried out.

With the techniques in this parser it would be possible to design an AI application that understood GET THE RUNNERS TO THE FOUR THIRTY AT ASCOT AND TELL ME WHO YOU THINK WILL WIN or in an adventure game: SAY HELLO TO ROGER AND THEN HIT HIM WITH THE BRICK. GO SOUTH, GET THE BOTTLE AND FILL IT WITH WATER AFTER EATING SOME FOOD.

There are several problems with trying to make sense of so much. One problem is that we are allowing pronouns – words like 'it', 'him' and 'them'. These sort of words are easy for us to understand but for a parser it presents a special type of problem.

Another problem is ordering. A word like 'after' changes the order in which actions are to be carried out. This is important if you say something like GO THROUGH THE DOOR AFTER KILLING THE DRAGON – dragons are notorious for not letting you through doors unless they are dead.

So, how to deal with these two problems? I used the following approach.

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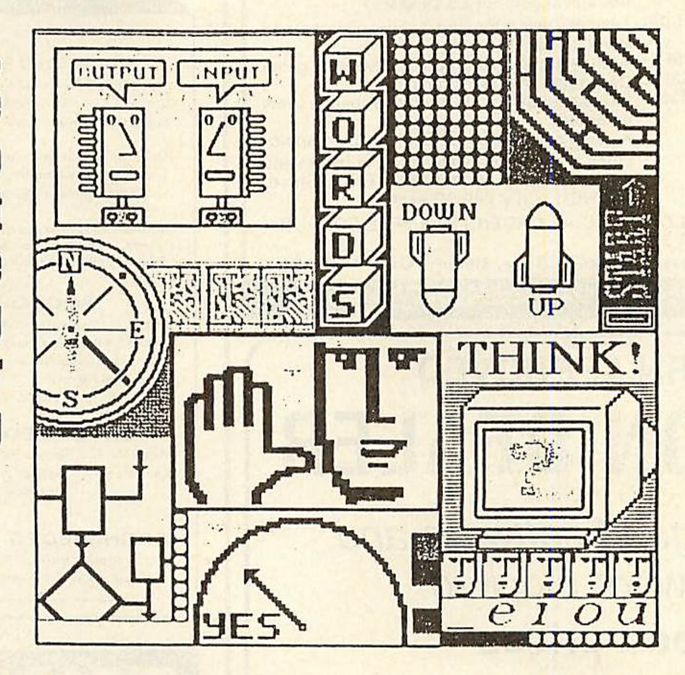
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- Remove punctuation
- Remove words we do not need
- Replace pronouns with correct noun
- Split input into separate tasks
- Order tasks so they are carried out in the correct order.
- Pass control to the relevant subroutines.

Listing 3 uses this approach and will cope with a sentence like the ones above.

Much of the program is similar to the last two. PROCremovepunctuation removes the punctuation symbols held in DATA from the input. Our sentence now reads: SAY HELLO TO ROGER AND THEN HIT HIM WITH THE BRICK GO SOUTH GET THE BOTTLE AND FILL IT WITH WATER AFTER EATING SOME FOOD.

PROCdeleterubbish deletes the words (also held in DATA statements) from the input string. The DATA statement have a space either side of the words so the string functions are easier to program.

Once these words have been removed the input reads: SAY HELLO ROGER HIT HIM BRICK GO SOUTH GET BOTTLE FILL IT WATER AFTER EATING FOOD.

Now PROCreplacepronouns replaces the pronouns with the correct nouns by determining which we are replacing and then copying the nouns that could be replaced by this pronoun into the array temp$.

For example if an occurrence of 'him' is found in the input string the pronoun will be replaced by a male name and so the array male$ will be copied to temp$. This is done by calling the subroutine at 1400.

If the pronoun was the word 'it' the subroutine at line 1460 would be called to copy the array noun$ into temp$. Which subroutine is called is decided by the number that is held with the pronoun as DATA.

Each word in the array temp$ is checked to see if it can be located in the input string. If the word is found, it is checked to see if it occurs before and closer to the pronoun.

For example, with the sentence SAY HELLO TO ROGER AND THEN SWEAR AT PETER. NOW HIT HIM WITH THE BRICK, to replace 'him', first the procedure would recognise that this pronoun should be replaced by a male character. It would therefore copy the array male$ to temp$.

The procedure looks at each of the male characters and checks its position against the pronoun. When it checks 'Roger', it sees that it appears before the pronoun and would remember its position as a possible replacement for the pronoun.

When 'Peter' is checked, the procedure finds this word also appears before the pronoun. It would now check against the position of the other remembered noun and find 'Peter' is closer than 'Roger'. 'Peter' would replace the pronoun.

This procedure also ensures the sentence makes sense by checking for a noun of the correct type before the pronoun. So, HIT HIM WITH THE BRICK generates an error because the computer does not know who to hit.

Now PROCseparateactions splits the input into separate actions. The position of each verb is logged into successive elements of act_ptr% and this array is sorted into numeric order.

The input string is split at the verb boundaries using the logged verb positions and the individual actions are placed in successive elements of action$(n).

The procedure works in this way because it needs to know the order in which the verbs occur in the input string before it can split the string up.

For our original sentence, action$ will look like this:

```
ACTION$(1)="SAY HELLO ROGER"
ACTION$(2)="HIT ROGER BRICK"
ACTION$(3)="GO SOUTH"
ACTION$(4)="GET BOTTLE"
ACTION$(5)="FILL BOTTLE WATER AFTER"
ACTION$(6)="EATING FOOD"
```

Each action is now a verb followed by a number of nouns – the same situation we had with the second parser. The only difference is that now there are a number of actions to perform and we have to make sure they are processed in the correct order. PROCorderactions does this.

The procedure assumes the actions will be carried out in ascending order but if it hits a word such as 'after' the order numbers stored in act ptr% are altered. The program can only cater for 'after' but it can easily be amended to allow for, say, the word 'before'. The procedure also strips off the ordering words otherwise they will be passed as nouns to the various subroutines.

PROCdisplayactions displays the actions in the order they will be processed. Again, in a 'real' parser this procedure would call the various verb subroutines passing the nouns as parameters.

Listing 3 is designed only to demonstrate some of the techniques which can be used when writing a parser. I do not suggest you plug it directly into your programs! It has also not been written with memory considerations in mind. In a real application it would be sensible to hold the text outside the program and use text compression to reduce the memory needed.

Although it is clear that even with an extended version of listing 3, not every sentence uttered by mankind will be understandable to a micro, but by using these techniques the day when you will be talking to your Beeb or Arc is that bit closer.

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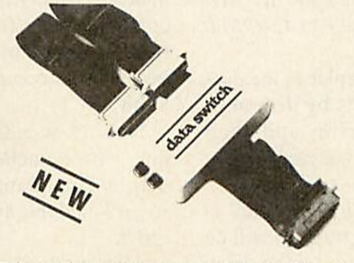
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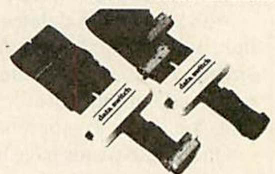


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The most famous 'test' for Artificial Intelligence is the 'Turing Test' conceived in 1950 by Alan Turing. This has you interrogating a computer and a human by way of written messages to deduce which is the machine. The computer is said to have passed the test, and thereby exhibited intelligence, if you cannot guess which is which.

No computer has yet managed consistently to pass the Turing Test although successes have been made in small and rather limited situations.

A good example of a program failing the test would be the old favourite animal guessing game. This is a program where you are invited to think of an animal (or anything else, really) and it then attempts to guess what it is.

To perform this task, the program has a 'tree' of possible animals and questions requiring simple Yes or No answers – like the one in figure 1. If you start at the 'top' (root) of the tree and trace down any of the 'branches' (arcs) answering the questions, you will eventually reach an animal – the actual one depending on your replies.

This is, in fact, how the program guesses your animal – the program starts at the root of the tree and asks the first question, it then branches left or right depending on your response. Subsequent enquiries and branches are made until a leaf is reached at which point the program thinks it has guessed your animal and asks 'Is it ... ?'. If you answer 'Yes' to this question, the program thinks itself very clever and awards itself some Brownie points.

But what, I here you say, happens if you think of an animal that the program doesn't know yet?

Well, let us suppose you were thinking of a horse and the program contained the questions and animals of figure 1 (ignoring the dotted region for now). It would arrive at the 'rabbit' leaf and suggest that.

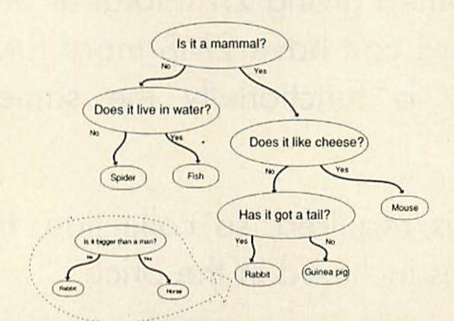


Figure 1. The old animals tree

When you reply 'No' it would ask for a question which distinguishes between a rabbit and a horse.

The rabbit leaf would then be replaced by the sub-tree shown in dotted area in figure 1 and the program would then be able to guess if you were thinking of a horse again.

However, this is rather an inefficient way of guessing an animal for a number of reasons. First, responses are restricted to a binary choice. It is time consuming to ascertain, for example, the number of legs the animal possessed with only 'Yes' and 'No' as possible replies.

Answers to questions are only known about animals 'below' the question node in the tree. For example, in figure 1, it is not known if spiders and fish have tails or not. Questions often have to be duplicated in different parts of the tree. This is clearly a waste of memory (and tree) space.

Also, questions are only ever added at the bottom of the tree. This can lead to unbalanced trees possibly with important questions being asked too late. For example, it wouldn't be very sensible to ask 'Has it got two arms?' before 'Is it a mammal?'.

When a new animal and question are added, only a relatively small amount of new knowledge is added – just the 'difference' between your animal and the computer's guess.

These last two problems lead to the program being a slow learner – not naturally inquisitive! It would certainly not pass the Turing Test, because for any given animal, it always asks the same questions in the same order. It also only has one guess at each animal. If it's not the first one it finds, it gives up.

What can be done to cure these problems? My solution was a two stage one. I started by extending the data structure and program as much as possible, this solved the two trivial limitations of the original program. The others proved to be a little more tricky and required a major rework to overcome them.

The first solution

My first thought was to extended the binary tree into an 'n-ary' tree, replacing the yes/no questions with multiple choice questions with a list of possible answers. This would lead to a structure similar to the one in figure 2.

As before, the nodes contain questions and the leaves contain animals. However, now the tree is not restricted to just two subtrees per node.

The guessing algorithm is virtually identical to the binary version with the obvious multi-choice extension to question asking –

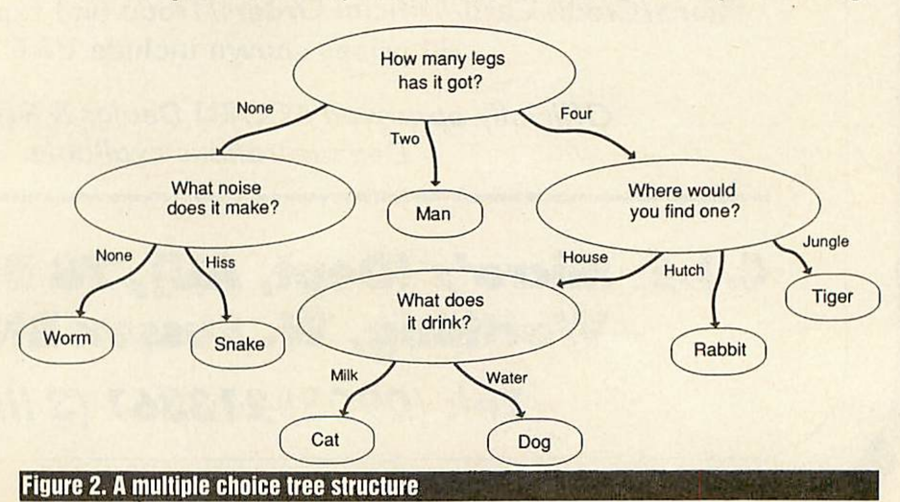


Figure 2. A multiple choice tree structure

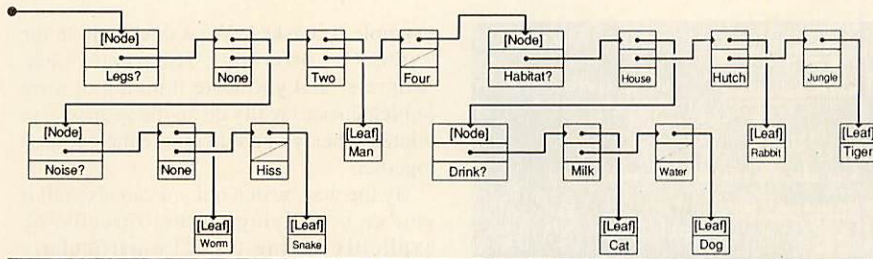


Figure 3. The data structure for the AI-Tree program

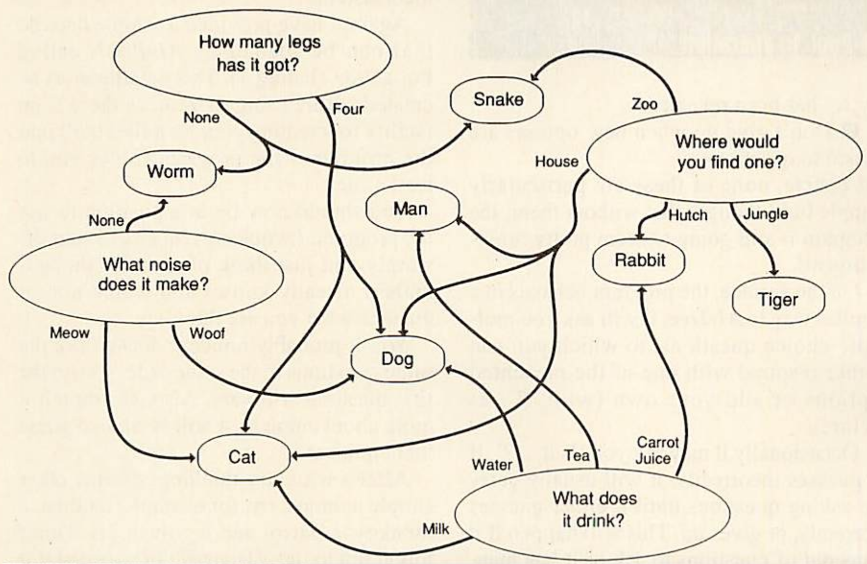


Figure 4. The basic tree for the improved AI-Pool program

the branching and final 'Is it ... ?' are the same as before.

The first slight problem with this program comes when you think of, say, a hedgehog, with the structure in figure 3. When you get to 'Where would you find one?', none of the responses is really valid for a hedgehog!

So I have provided an extra option – '?' – which means 'add an answer to this question'. The program would then ask what animal you were thinking of and also what the answer to that question was for your animal. The tree would then be updated accordingly.

I also tried to solve some of the balancing problem related to trees. The 'best' way to do this would be to rebalance the tree every time it is updated. This would involve analysing the whole tree, breaking it down and rebuilding it from scratch.

This is, however, quite time consuming, and not necessarily possible, because of the second problem – not everything is known about all the animals. I mean, what does a snake drink?

So, I came up with a 'work round'. This appears in the program as the '^' option which adds in a new question above the current question in the tree.

For example, if you were thinking of a lizard and thought that 'What type of animal is it?' would be more relevant than 'Where would you find one?', pressing '^' would ask you for the animal you were thinking of, your new question and the answers for your chosen animal and the rest of the subtree.

Of course, this is really only a work round bodge, as you would need to be sure that all the animals in the subtree were mammals, which they may not be.

A version of this program (*AI-Tree*) appears in the yellow pages. I have also provided a datafile containing the data structure illustrated in figure 3. To use this, type in the text (in listing 3) into *!Edit* or *Twin* and save it as TREEDATA before running *AI-Tree*. This can be loaded into the main program.

On running *AI-Tree*, you'll first be asked if you want to load a file. To experiment for the moment, answer 'Y', and enter TREEDATA as the filename. If you answer 'N', you'll be presented with various questions that you can answer to initialise your own tree.

Once the program is running, using it should be fairly self explanatory, simply answer the questions given with the appropriate letter key or use '?' and '^' as already indicated above.

When you've had enough, press ESCAPE. This will first ask you if you want to save the current state of the tree in a file and then return to Basic.

As you may have guessed, the data is not really stored internally as a series of circles and lines! Figure 3 is a representation of the actual data structure employed. I have used the indirection operator, !, to emulate the 'pointers' and 'structures' available in languages such as Pascal and C.

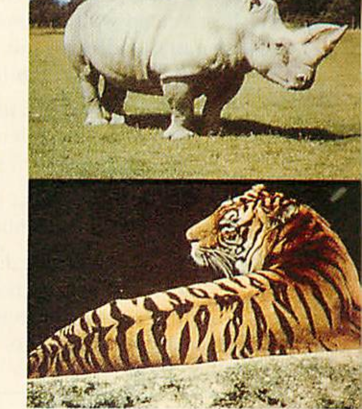
A start pointer points to the first object in the tree (this is always a question). Questions and animals are distinguished by a flag, either 'Node' or 'Leaf'.

A 'Node' (a question) contains the actual text of the question and a pointer to a list of options. These consist of the text of a response to the question, a pointer to the next option (or Null, a value of 0, if it is the last one) and a pointer to the subtree for that particular response.



A 'Leaf' (an animal) simply contains the name of the animal.

I'm sure all this will become clear with reference to figure 4! The program itself should be fairly easy to follow and modify if you so wish.



One further point of interest is the format of the saved datafiles. These are plain text files and can be inspected with *TYPE or *!Edit*. Because the tree is recursive in nature, it is saved in a recursive fashion. PROCsave_tree is called with the start pointer to save the whole tree, this then either calls PROCsave_node or PROCsave_leaf depending on the 'contents' of the pointer.

PROCsave_node first writes the question to the file (with a prefixed '?') and then for each option it has, recursively calls PROCsave_tree to save the sub-tree and then writes out the text of the response to the file (with a prefixed '>').

PROCsave_leaf simply writes the name of the animal to the file (with a prefixed space). PROCload_tree just reverses this process, again recursively, and this recreates the tree.

Well all this is clearly an improvement over the basic animal guesser but again, it would quickly fail the Turing Test and still does not exhibit any real intelligence – even an artificial one. It also leaves the other criticisms of the first program untouched.

The second stage of my improvements involves some major re-thinking. Some of the ideas and concepts may be a little tricky

to grasp at first reading, so don't worry if you don't immediately understand – you can still play with the finished program and maybe see if you think it would pass the Turing Test!

The final solution

The major limiting factor of *AI-Tree* is the tree data structure, in fact it is what makes the program seem mechanical and so fail the Turing Test.

I wanted my new program to have a more realistic model of data storage, the most sensible system seemed to be to have a pool of questions and objects with links between them. These links would connect a question to an object and be labelled with the response to the question for that object. Figure 4 should make this clear.

There is by no means a link between every question and every object and there is no ordering of questions or objects. This means the program doesn't know everything about everything yet, such as, for example, what a tiger drinks.

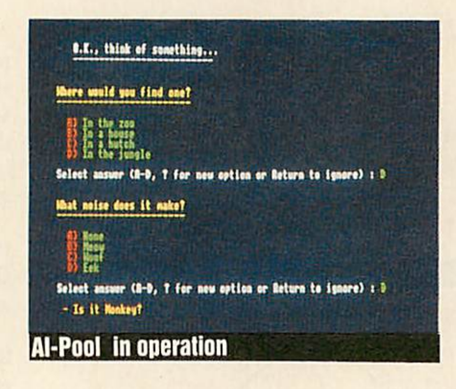
That was the easy bit! The real problem came when trying to write an algorithm to deal with this data structure.

I tried to base it on what I would do if presented with the problem of guessing an animal and, with this in mind, I came up with the following guidelines:

● Always ask the most 'useful' question – one that would split up the number of possible objects as much as possible.

● Guess an object if it seems likely but don't give up if it's not right.

● Try to increase the amount of 'knowledge' – attempt to find out as much as possible about new objects, but without asking hundreds of tedious questions after the



AI-Pool in operation

object has been revealed.

● Don't give up when new options are added to questions.

Of course, none of these are particularly simple but I thought that without them, the program is still going to seem pretty 'unintelligent'.

On the surface, the program behaves in a similar way to *AI-Tree*, it will ask you multiple-choice questions, to which you can either respond with one of the presented options or add your own (with '?', as before).

Occasionally it may ask you 'Is it ... ?'. If it guesses incorrectly, it will usually carry on asking questions until it either guesses correctly, or gives up. This will happen if it runs out of questions to ask or it has managed to eliminate all the objects it knows about. When this happens, it will ask you to tell it what you were thinking of and if you want to add a new question to help distinguish your object. If you don't, then it won't mind but may force you to enter one later if it cannot isolate that object!

If it ever asks you a question that doesn't seem relevant, you can ignore it and not give an answer by pressing RETURN. For example if it asked 'What does it do in the winter?', offering 'Hibernate' and 'Migrate' and you were thinking of a cat (which doesn't really do anything special in winter!) then you could ignore the question together.

By the way, watch out – it can also tell if you've been lying! Either directly, by explicitly saying it isn't a particularly object or indirectly, if your responses are inconsistent!

Again, I have provided a sample datafile that can be loaded by *AI-Pool*, called POOLDATA (listing 4). This datafile must be created before using *AI-Pool* as there is no facility for creating your own files built into the program – the program forces you to load a file.

You should now be in a position to use the program. I would advise you to start off simply and just think of some of the animals it already knows and watch how it guesses what you are thinking.

You'll probably notice it doesn't ask the same questions in the same order – even the first question will vary. Also, as you tell it more about animals, it will be able to guess them quicker.

After a while try thinking of some other simple animals, try, for example, a kitten, a monkey, a parrot and a guinea pig. Don't forget not to lie! Also don't be alarmed if it makes some seemingly wild guesses, most noticeably it may seem to always ask you 'Is it a tiger?' even though you've said it drinks milk, has two legs and makes no noise! It's just being inquisitive and wants to know about tigers – if you look in figure 5, you'll see that at the start it knows hardly anything about them!

You may notice it will be able guess things much quicker if you think of them more than once – it is trying to isolate your object and eliminate others as quickly as possible, so on its first attempt you are giving it lots of information it can use on its second attempt.

It will also not give up if, for example, you are thinking of a man and in response to 'What noise does it make?', you don't respond with one of its own options but add the option 'It talks' – it will just eliminate Worm, Dog and Cat and continue asking questions. It will assume you are thinking of one of the four other animals, of which so far it doesn't know anything about their vocal ability.

When it eventually guesses it was a man, (which it will), it will be able to add in the fact that a man talks.

As with *AI-Tree*, pressing ESCAPE will first invite you to enter a filename (this defaults to the name you entered at the start) and will then return to Basic.

The internal representation of all this data is quite complex. Figure 5 illustrates how the data in figure 4 would actually be

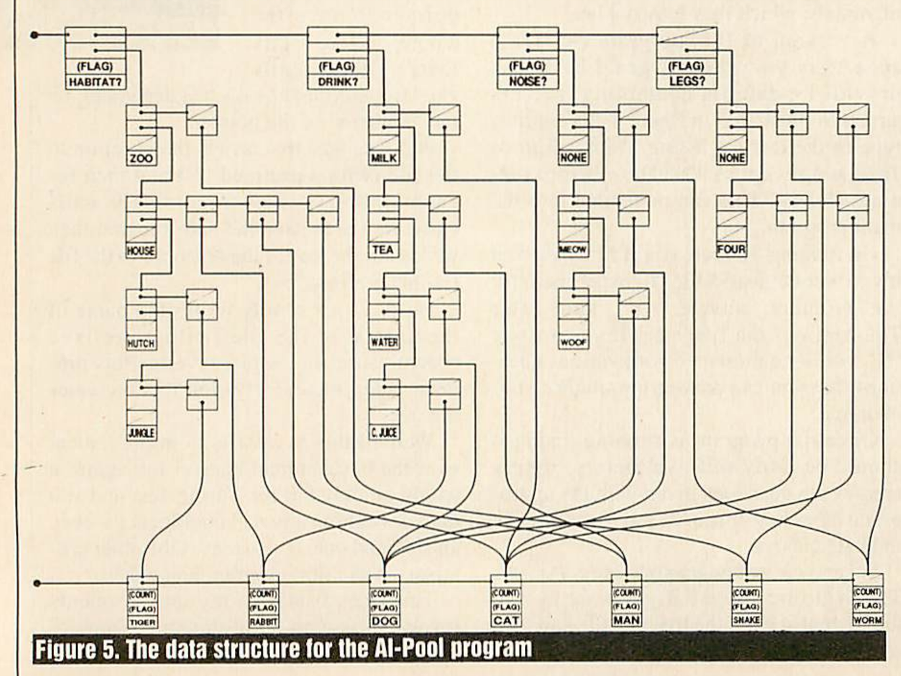


Figure 5. The data structure for the AI-Pool program

stored and this only shows four questions and seven objects!

I have split the diagram into the two pools the program maintains, questions and objects, although actually there is no clear division. Two start pointers are kept, these point to the first question and the first object respectively.

Offset	Contents
0	Pointer to next object (or null)
4	'probability' counter
8	'valid' flag
9	Text of object

By 'next' object, I mean next in the linked list of objects – don't forget there is no order to the objects or questions. The last object is shown by having a null pointer.

The probability counter starts off at zero, and is incremented by one every time it's judged this object could be the one you are thinking of. It is used by the 'best bet' part of the guessing algorithm.

The 'valid' flag starts off as TRUE and is set to FALSE if this object has been discarded. This is used to tell if you've been lying.

For example, if, in response to 'Where does it live?', you said 'In a house', the counters in 'Dog', 'Cat' and 'Man' would be incremented, and the valid flags in 'Tiger', 'Rabbit', 'Snake' and 'Worm' would be set to false.

Each question contains four fields:

Offset	Contents
0	Pointer to next question (or null)
4	Pointer to first option
8	'asked' flag
9	Text of question

Once a question has been asked, it is marked and will then not be used again. The 'option pointer' points to a linked list of options. These are the possible responses to the question.

Each option contains four fields:

Offset	Contents
0	Pointer to possible 'answers'
4	Pointer to next option (or null)
8	Pointer to next response
12	Text of option (response)

The 'next option' pointer simply points to the next option for this question. The 'next response' pointer is used to link in any new facts once an object has been guessed. When you respond to questions given, your replies are linked together with these pointers. When the program finally knows your object, this linked list is analysed, and any responses not previously known are added to the relevant questions.

Each option has to have a list of 'answers'. These simply contain:

Offset	Contents
0	Pointer to next answer (or null)
4	Pointer to object

These are used to connect the two pools of questions and objects. In other words they point to all the objects that have that option as a response to the question!

The actual mechanics of the program are fairly obvious once you have a working knowledge of the data structure.

Choosing a question

How does it decide which is the 'best' question to ask? Of course this is really subjective but from a statistical point of view, the method used seems to work quite well. Each question needs to be evaluated by some mathematical means - the only information we have for each question is the number of responses, the number of answers per response and the number of 'unknowns' (objects for which we do not know the answer to the question).

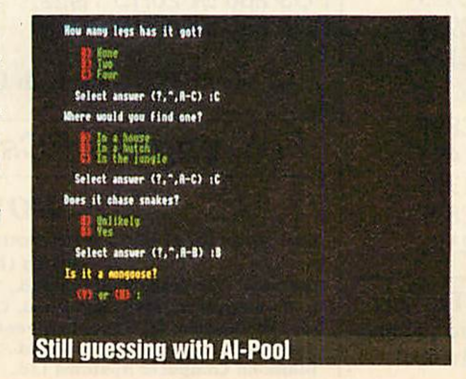
To simplify the problem temporarily, assume we have a set of 24 objects and six questions all of which have three responses (A, B and C), only the number of answers per responses differing:

Question	A	B	C	unknown
1	24	0	0	0
2	12	12	0	0
3	8	8	8	0
4	0	0	0	24
5	6	6	6	6
6	8	8	-	8

Which would be the best question to ask? Fairly obviously, question 1 is a wash out, if you reply A, it has not narrowed the search down while answering B or C will result in a dead end. A similar problem will result with question 2, although maybe this would not be quite so bad.

In other words we need to ask a question that will split up the objects as evenly as possible, so maybe question 3 would be the best, as any reply will narrow the rest of the search down to eight objects. So how can we tell which questions have this property?

Luckily, there's standard deviation. If we calculate the SD of the number of answers per response and pick the question with the lowest value, we will narrow the search. But what about the unknowns? Question 4 would then also have an SD of 0 and it doesn't look like a good question to ask!



Still guessing with AI-Pool

The number of unknowns must therefore also be included in the SD calculation. This would then lead to question 5 being the best bet. But what about question 6 (which only has two responses)? It also has an SD of 0. I personally think that question 5 would be the best and so the program picks the question with the fewest unknowns in the event of an SD tie.

All this calculation can be found in FNchoose, which picks the best question from those left. You may like to fiddle with this function to change the way the program 'thinks'.

If the program runs out of questions but still has some objects left, it uses the 'probability counters' to have a stab in the dark at what the object might be – it simply picks the object with the highest number of 'correct' responses so far.

If you wish to create your own datafiles, the format illustrated by POOLDATA must be adhered to – a list of objects on separate lines followed by a blank line then a list of questions, each prefixed by a '?' then a list of options, prefixed by a '>' then a list of objects prefixed by a space.

I think you'll agree that this is a vast improvement over both of the tree based guessing games. It has multi-choice questions, potentially with responses known for each object for each question. Questions do not need to be duplicated anywhere and new ones are simply added to the pool and may 'migrate' to being the most 'important' and the first asked.

Finally, even if you think about an object that it already knows about, it may still be able to add to its knowledge.

That answers my five earlier criticisms so perhaps the whole problem is now solved. Or is it? Do you think this program would stand up to the Turing Test? Probably not, but it would last a bit longer than *AI-Tree*.

Although it is quite satisfying when it does successfully deduce what you are thinking of by some very devious route of eliminating the impossible, it would most likely be viewed as an inquisitive alien (no human would really ask if a silent, milk drinking biped was a tiger!) – Artificial Intelligence with the accent on 'artificial'.

The BBC Acorn User Cobol compiler continues with the runtime interpreter and a full explanation of how compilers work from expert **JEFFREY MORGAN**

BUSINESS DETAILS

All Beeb users are familiar with at least one language – Basic is the standard high level language on the Beeb. Basic is an interpreted language – each line of a program is evaluated and routines in the Basic Rom carry out the tasks required. No code is actually generated during the execution of a Basic program.

If you have used languages such as Acornsoft's ISO Pascal or C, you will be familiar with the process of compilation. Basically when a program (called the source code) is compiled it is translated statement by statement into its machine code equivalent (called the object code).

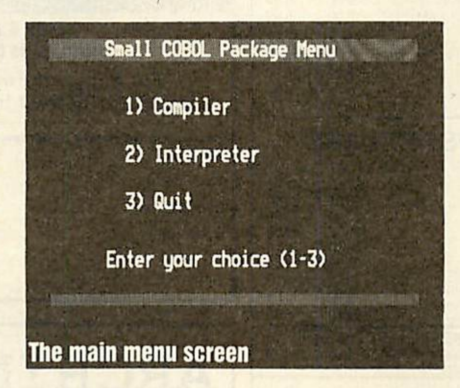
The Cobol compiler

To illustrate how a complex piece of software such as a compiler can be written in Basic, the Small Cobol compiler program will be used.

A detailed knowledge of Cobol is not required to understand the basics of a compiler since they are much the same for every language. However, the Cobol language was covered in detail in last month's issue and should if possible be used as a reference when reading this article since most examples involve Cobol.

The package is divided into two main parts – the compiler and the runtime interpreter, both selected by a main menu. The compiler converts your Cobol program into an intermediate pseudo-code (pcode) which is then executed by the runtime interpreter. This program is required because memory limitations prohibit machine code generation.

The compiler for this Small Cobol was given in the yellow pages last month. This month the runtime interpreter is listed. Along with both compiler and runtime interpreter programs, there are also two example programs on the yellow pages and this month's monthly disc. The first of these inputs a number of names and ages and the second displays the data in a different form.



The main menu screen

The design of a compiler is determined by the source language to be compiled and the object code to be produced. This is a single pass compiler. The source code is read only once. Forward referencing is required when labels are used and when records are being defined.

The four basic stages of compilation are lexical analysis, syntax analysis, relocatable code generation and error handling. All stages are done 'simultaneously' – each line undergoes each stage. Now a look at each in detail.

Lexical analysis is the first stage and it does a number of tasks. It converts the source text program into a form independent of the input device. This really applies to larger computers with a number of input devices that use different codes to store programs.

All recognised keywords, variables and so on must be converted to the appropriate tokens. During this process all redundant spaces and comments are removed.

So each program line is in a standard compacted form which can be passed on to the next stage.

The function FNgl performs this task by getting words from the source file using FNgw. The FNlex function converts the keywords into their equivalent tokens. Words and tokens are placed in the arrays ln$ and ln% respectively.

Syntax analysis involves the compiler checking that each program line has a valid structure and each command is used in the correct context (See later for more detail).

Relocatable code

This stage actually produces the machine code program that will eventually be run. It is important the code be relocatable since it must be able to be loaded into any area of memory and executed. This is specially important in large multi-programming systems where a program must go where the program scheduler sends it.

The pcode used is taken from the array ln% and copied to the array pc% with the function FNatp.

Error handling

Each of the above stages can produce errors. The function FNderr displays normal errors while the procedure PROCdismiss displays missing statements.

The compiler and the runtime interpreter produce appropriate error messages as required. When an error does occur it is displayed inside a set of chevrons:

```
>>> SYNTAX ERROR <<<
```

Figure 1 lists the error messages produced by the compiler. Compilation continues after an error unless a 'fatal' error (numbers 20 to 23) occurs.

When an error occurs in a Cobol program during compilation, the compiler does its best to continue. However, if one error occurs then several errors may be caused (this occurs with most other compilers).

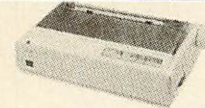
So it is best to de-bug each error as it occurs in the program. You may be surprised in certain cases to see the rest of the errors disappear completely when that first error is fixed.

After a number of errors the compiler sometimes gets a little flustered and may start spewing unwarranted errors – it is best

```
 1. Syntax
 2. No such variable
 3. Types incompatible
 4. Label exists
 5. No such label
 6. Variable already defined
 7. Bad picture
 8. Too many files
 9. Undefined file
10. No such file
11. Not in working strorage
12. Line too long
13. Number too long
14. Undeclared file
15. Bad level
16. Invalid level
17. Invalid filename
18. No quotes (missing quotes)
19. Missing label.
20. Too many fields
21. Too many lables
22. Too many literals
23. No pcode space left
24. Full stop expected
25. Word to long
26. Record too long
27. Literal too long
```

Figure 1. Compiler error messages

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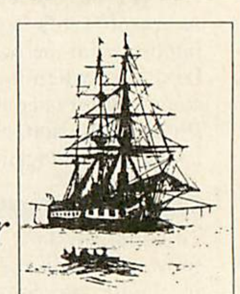
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```
1. Number too big
2. End of file
3. File closed
4. File already open
5. File write only
6. File read only
7. No such file
8. File can't extend
9. Disk is full
1Ø. File is locked
11. Catalogue full
12. Disk is read only
13. Division by zero
```

Figure 2. Runtime interpreter errors

to simply ignore these!

If an error occurs when running a program, the runtime interpreter will display the error and halt execution of the program. You will then be returned to the main menu after pressing SPACE. Figure 2 lists the runtime error messages.

In the unlikely event of an error occuring in either the compiler or the runtime interpreter, the program displays 'Sorry, can't continue. An error has occured in the Compiler/Runtime interpreter itself' followed by the error itself. In this event you should, if possible, fix the error and then reload the package and start again.

Throughout the compiler e% is an error flag that contains an error number when greater then zero.

The symbol table

The symbol table of a compiler is constructed during lexical and syntax analysis. It is made up of a number of lists and tables that hold information concerning keywords, variables and the like. PROCres reserves space for new variables.

The arrays that make up the symbol table are as follows :

- tbl$ – holds keywords
- dt$ – holds the file's records
- nm$ – holds the names of all variables
- ptr% – holds pointers to start of each field's data
- tp$ – holds the type of each variable
- len% – holds the length of each field
- pt% – holds the position of a decimal point (if used)

When compulsory statements are encountered, the appropriate array element of sta% (state) is set true. If any of the compulsory statements are missing then an error is generated.

```
Ø1 MASTER.
   Ø2 NAME.
      Ø3 SURNAME PIC X(2Ø).
      Ø3 FORNAME PIC X(2Ø).
   Ø2 ADDRESS.
      Ø3 NUMBER PIC X(3).
      Ø3 ROAD PIC X(2Ø).
   Ø2 AGE PIC 99.
   Ø2 PAY PIC 9999V99.
```

Field No.	Field Name	Length	Type
1	MASTER	Ø	|29
2	NAME	Ø	|34
3	SURNAME	2Ø	X
4	FORNAME	2Ø	X
5	ADDRESS	Ø	|67
6	NUMBER	3	X
7	ROAD	2Ø	X
8	AGE	2	9
9	PAY	6	9

Figure 3. Example Cobol data record

Memory management

For each of the six available files one record at a time from each can be in memory. Fields of each record are stored as part of a string representing the whole record and these are located by a system of pointers.

The data structure of a record is a very important part of the compiler as it is this program that constructs the internal representation for the runtime interpreter to operate on.

Figure 3 shows an example Cobol data record and how the record would be represented internally. A zero in the length column means the particular field is the start of a set of sub-fields.

The field 'type' shows what type of data can be held in that field – alphabetic (A), numeric (9) and anything (X). A field with a type starting with the double bar character '|' is the start of a set of sub-fields. 29 indicates that field 1, MASTER is the beginning of a set of sub-fields starting with field 2 and ending with field 9. 34 indicates that field 2 is the beginning of another set of sub-fields starting with field 3 and ending with field 4.

```
SURNAME     BLOGGS
FORNAME     FRED
NUMBER      27a
ROAD        ACACIA AVENUE
AGE         63
PAY         275.65

BLOGGS..............FRED...
..............27aACACIA AVEN
UE......63.275.65
```

Figure 4. Data storage in a string

Figure 4 shows how the data in the record defined in figure 3, would be stored in a string.

The pcode

The compiler doesn't produce pure machine code. Each program is translated as far as possible into a compact code of integers and various lists of the symbol table. This code is then interpreted by the runtime interpreter. It would be possible as an enhancement, to design a program that converts the pcode into pure machine code.

The only part of a Cobol program that produces a pcode that is stored is the procedure division. However, the rest of the program isn't redundant, for example the data division is directly responsible for the construction of the symbol table.

Some elements of the pcode have more than one meaning which depend on the context in which the item occurs:

```
-1  : An unrecognised word or a
      label not yet defined.
2-digit
integer
<6Ø : Cobol keyword
      file number (Ø-5)
      label number (Ø-2Ø)
      literal number (Ø-2Ø)

>6Ø : variable number
```

The variable number is a code calculated using the formula:

```
(file number+1)x1ØØ+field number
```

For example 206 represents file 1, field 6. Using DIV and MOD the file and the field number can be extracted from a single number.

When compiling the example programs, make the compiler display the pcode and compare the pcode, the keywords represented by the numbers and the programming constructions to see how they relate to each other.

```
Small COBOL RunTime Interpreter
47 34 -1
54 602 55 603 47 92 -1
14 -1

14 4 602 -1
Enter record :  1
14 -1

14 5 -1
Forname :
19 1 -1
>>Jeffrey
9 201 103 -1
14 6 -1
Surname :
19 1 -1
>>Morgan
9 201 104 -1
14 7 -1
Age :
19 2 -1
>>
```

The runtime interpreter in operation

All statements produce pcode but only those preceded by a plus become part of the pcode program. Only the items of pcode that are necessary are used. For example the following Cobol statement:

```
ADD BONUS TO GROSS_PAY GIVING PAY.
```

would be directly translated into:

```
1Ø 6Ø2 38 6Ø6 41 6Ø1
```

assuming that BONUS, GROSS_PAY and PAY are represented by 602, 606 and 601 respectively. It would, however, be stored as:

```
1Ø 6Ø2 6Ø6 6Ø1
```

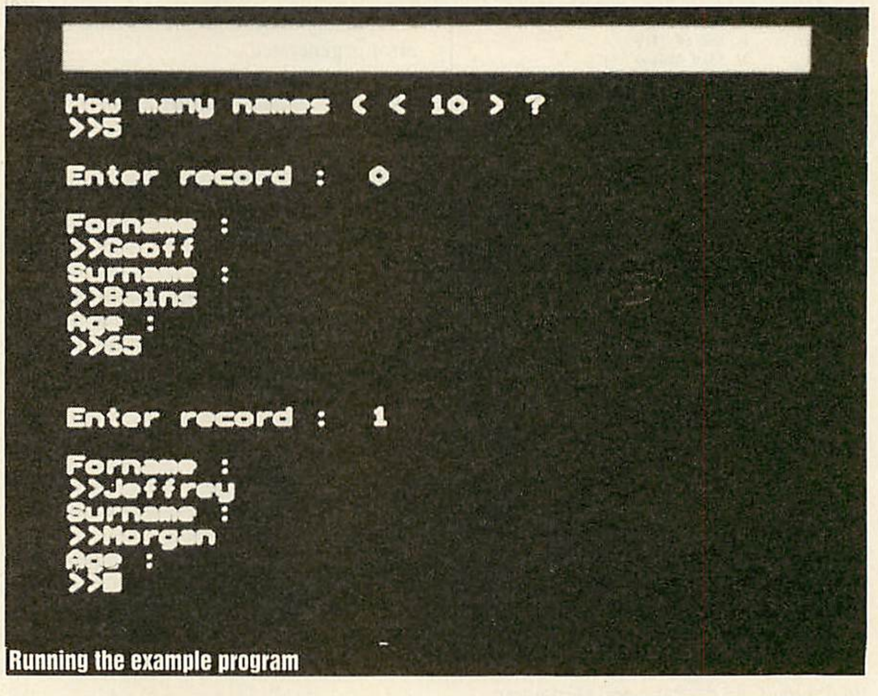
as the keywords TO and GIVING are not needed to execute the command. The runtime interpreter decodes the three tokens after the add token (10) and carries out the appropriate actions. The resulting pcode is as compact as possible.

More syntax analysis

Syntax analysis on this statement, performed by the function FNchsyn, goes as follows. First the initial token 10 (ADD) is used in an ON...GOTO statement to call the function FNchcomplex. Then the third token is checked that it is 38 and that the fifth is 41. The second, fourth and last tokens are checked for validity by FNtest_var. If any of the tokens of a statement are invalid then a syntax error is generated.

All statements are checked in a similar way to this. The structure of Cobol statements makes them easy to verify for syntax, but the process is quite cumbersome.

Other languages, such as Pascal and Modular 2 can be completely defined by a system called 'Backus Naur Form'. This is immensely complex but with the use of recursion and a bit of slick programming you can write your own syntax analyser (in Basic) to handle a language such as Pascal.



Running the example program

File structures

The three types of file associated with Cobol programs are the source code file, the datafiles used by the programs and the pcode file itself – all of which are sequentially accessed.

The structure of the datafiles created and used by Cobol programs relies entirely on the programmer.

Figure 5 shows the structure of all pcode files. The item CONTENTS OF FILE n is the current contents of the file's record as defined by the VALUE IS clause in the data division. The item FILE NAME is the external filename of the file. The item FILE TYPE defines whether the file is an input file (-1) or an output file (1).

Figure 6 shows the item FILE n DETAILS to make the figure less complicated. All of these items have the same structure but not necessarily the same length. The START POINTER is -1 in the last field.

```
<THE PCODE> n integers. (Ø<n<168)
<FILE 1 DETAILS>
<CONTENTS OF FILE 1>
<FILE 2 DETAILS>
<CONTENTS OF FILE 2>
<FILE 3 DETAILS>
<CONTENTS OF FILE 3>
<FILE 4 DETAILS>
<CONTENTS OF FILE 4>
<FILE 5 DETAILS>
<CONTENTS OF FILE 5>
<FILE 6 DETAILS>
<CONTENTS OF FILE 6>
<FILE NAME OF 1st EXTERNAL FILE>
<FILE TYPE OF 1st EXTERNAL FILE>
<FILE NAME OF 2nd EXTERNAL FILE>
<FILE TYPE OF 2nd EXTERNAL FILE>
<FILE NAME OF 3rd EXTERNAL FILE>
<FILE TYPE OF 3rd EXTERNAL FILE>
<FILE NAME OF 4th EXTERNAL FILE>
<FILE TYPE OF 4th EXTERNAL FILE>
<NUMBER OF LITERALS> 1 integer (n1)
<LITERALS> n1 strings
```

Figure 5. Pcode file structure

```
[<START POINTER> <TYPE> <LENGTH>] of field 1
[<START POINTER> <TYPE> <LENGTH>] of field 2
        "          "
        "          "
        "          "
<START POINTER><TYPE><LENGTH>] of field n (Ø<n<15)
```

Figure 6. File structure details

Executing commands

A quick word about the runtime interpreter. Although it is a long program it was the easier of the two to write since all the hard work is done by the compiler.

The main procedure is PROCdo which executes the pcode. The first token is used

```
READ BUFFER2.
MOVE NUMBERS TO AGE.
DISPLAY.
ADD INC TO COUNT GIVING COUNT.
WRITE INFO.
GO TO LOOP1.
ENDING.
CLOSE INFO BUFFER1 BUFFER2.
DISPLAY.
DISPLAY "INFO file created.".
RUN STOP.
---------------------------------------
Compilation of <C.NAMES> complete.
0 compilation error(s).
Pcode is 104(+) bytes long.
---------------------------------------
Press SPACE for MENU
```

Compiling the example program



Compiling the example program without displaying the pcode

in an ON...GOTO statement to determine which procedure is used to execute the appropriate command. If you look at the associated procedures and functions you will see they are relatively simple.

Since there is not really a need for algebraic expressions in Cobol they have not been implemented in the compiler. However, they are an important part of a compiler for other languages.

Take the expression for evaluating the area of a circle:

```
area=PI*(radius^2)
```

When evaluating an expression it is important the compiler is able to scan the expression from left to right without the need to back track over it. From this scan it must be able to unambiguously evaluate the expression while observing the precedence rules of mathematics – brackets must be evaluated first, multiplication and division must be carried out before addition and subtraction and so on.

To evaluate expressions the compiler uses Reverse Polish Notation (RPN). When an expression is encountered a syntax tree is created. The tree for the area expression can be seen in figure 7. This tree is created simply by setting up a binary tree in memory. To produce the RPN of the expression a post-order traversal of the tree must be done. Doing this will produce:

```
area PI radius 2 ^ * =
```

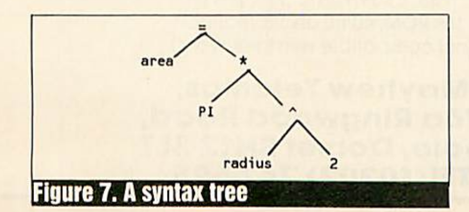


Figure 7. A syntax tree

This expression can now be unambiguously evaluated using a stack. Items (starting from the left) are pushed on to the stack until a binary operator (such as * or = or ^) is reached. Two items are 'popped' (removed) off the stack and, say, multiplied. The resulting number is then put back on the stack.

Figure 8 illustrates this process. All items inside represent the actual values – not the variables. Therefore at the conclusion of the process a number is left remaining on the stack.

The final operation makes 'area' equal to the value of PI*(radius^2).

STACK 1	STACK 2	STACK 3
<area>	<area>	<area>
<PI>	<PI>	<PI*(radius^2)>
<radius>	<radius^2>	
2		

Figure 8. Evaluating the RPN

Rolling your own

You should now have at least a basic knowledge of how to create your own compiler. I have listed some points you should have in mind when designing and writing your own compiler:

- Research the language thoroughly.
- Design distinct stages of compilation.
- Define the project on paper before coding, making it as flexible as possible.
- Try to write each stage as a separate program – testing each thoroughly.
- Write the lexical analyser first.
- Don't give up! With such a complex piece of software it is inevitable that major problems will occur.

Finally, think roughly how long it will take you to complete it. Then double or even treble this to get a realistic time!

Good luck.

The following books may provide you with further help:

Writing Interactive Compilers and Interpreters by P J Brown. Published by John Wiley & Sons.

Understanding & Writing Compilers by Richard Bornat. Published by Macmillan

Principals of Compiler Design by Alfred V Aho and Jeffrey D Ullman. Published by Addison Wesley

Compilers. Their Design and Construction Using Pascal by Robin Hunter. Published by John Wiley & Sons

```
Small COBOL Compiler
PROCEDURE DIVISION.
4 33
DISPLAY "CREATE NAMES FILE".
+14 1
DISPLAY.
+14
OPEN INPUT BUFFER1 BUFFER2.
+15 17 1 2
OPEN OUTPUT INFO.
+15 18 0
LOOP.
-1
DISPLAY "How many names ( <" MAX "> ?".
+14 2 604 3
READ BUFFER2.
+19 2
MOVE NUMBERS TO LAST.
+9 301 603
IF LAST GREATER THAN MAX GO TO LOOP.
+54 603 56 604 47 15
LOOP1.
```

Compilation with display of pcode

Dodgy discs can prove a headache for every user. **PHIL STRAFITER** comes to the rescue with a unique program which gets all your discs squeaky clean

BBC Acorn User Disc Servicer
Servicing track 4 (dirty)
Cleaning...

SPRING CLEAN

What can be more annoying than reaching into your disc box for your latest masterpiece of programming or literary opus only to find the gremlins have been at the disc and all you get out of your machine is some grating noises and a handful of random disc errors?

This has happened to me on a number of occasions and the only good to come out of it is I now keep a backup of each disc in every room of the house!

Of course it's all very well saying you should have made backups after the event but what can you do about those now rather useless discs? You can try cleaning your disc heads with one of the numerous degreasing and cleansing lotions available (I believe there are now even scented head cleaners available to make your drives smell nice!) but invariably you'll find this makes little or no difference.

This is hardly surprising as the real culprit is the disc itself.

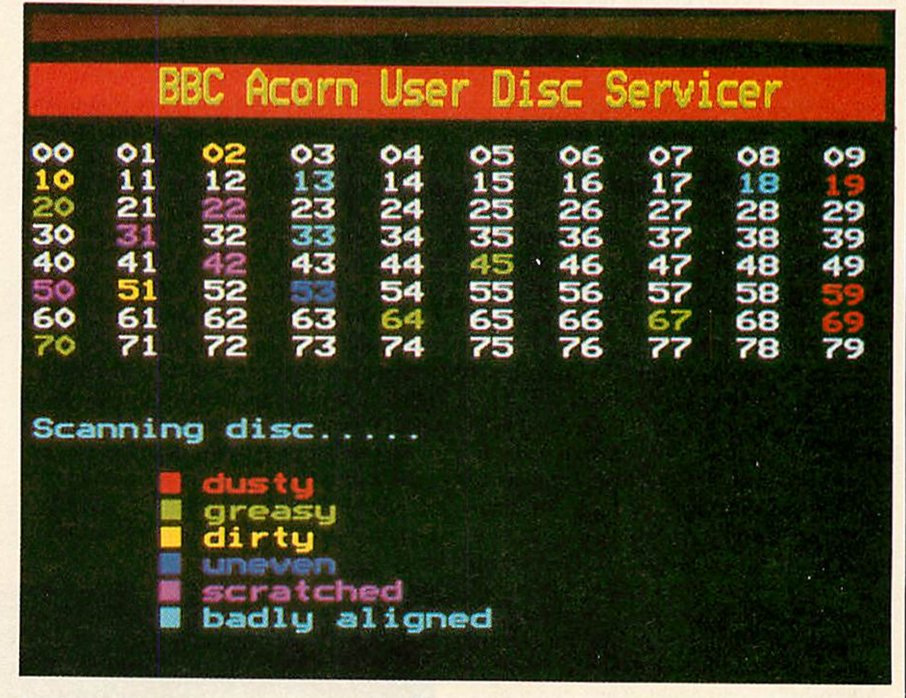
Many of you will be familiar with the figure on the right showing the disc surface greatly magnified and the size of dust particles in relation to the gap between the disc head and the disc. This, I hope, gives you some idea of the problem.

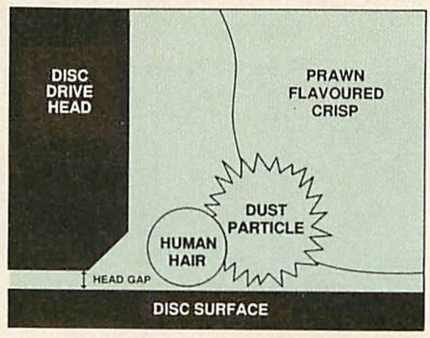
I've found that although it is actually possible to clean discs by hand (with a lint free cloth), it is far more efficient to get the computer to do it for you! Hence the program in this month's yellow pages.

This program uses standard operating system routines to scan the disc, locating possible problems on its surface and noting their locations. This is done by monitoring the height of the head above the disc surface and also the strength of the magnetic field – how 'clean' (no pun intended) the pulses read from the disc are.

This not only spots the dirty tracks but also badly aligned and bumpy tracks, all of which can cause a disc's downfall.

Once the disc has been scanned, the problem tracks are dealt with one at a time. Without getting too technical, standard OS routines are used (with a little machine code modification for some of the more speed critical tasks) to clean, scrub and generally overhaul your disc.





Using the program is trivial, simply type in the program and save it somewhere safe first (on a good disc!) then run it and put one of your faulty discs in any drive. The program will prompt you for which side to clean and how many tracks the disc has. You can then sit back and watch the disc being scanned and then 'serviced'.

Obviously it would be a good idea to clean your disc heads first with a commercial disc head cleaner. You don't want to cause more damage to your already battered disc!

Since writing the program, I now 'service' each of my discs after formatting them. I find this greatly improves the life span of new discs.

I am currently finishing off an Archimedes ADFS version of the program but that is proving a bit tricky because dust particles accumulate in the branches of complex directory trees. However, I should have the problem cracked in about a year. So, if you are having any problems with your Arc discs, keep them safe until the April 1991 issue.

CATCH ON TO

Control technology is forming a big part of the new National Curriculum. **CHRIS DRAGE** and **NICK EVANS** offer some advice on coping with this thorny subject

What is control technology? Well, it is the use of microelectronic devices to control other equipment in order to perform certain tasks. The controlling device is not necessarily a computer in the sense that most people would recognise it – a box, a monitor and keyboard. Your central heating control unit, washing machine dial and pelican crossings are all examples.

Its use in the classroom is intended to provide children with an understanding of the processes which influence their lives.

How does it affect me? Control technology affects you because it is now a statutory part of the National Curriculum. In effect, where it is appropriate, control and monitoring techniques should be integrated into normal design and technology work.

The National Curriculum Council has provided guidelines for the areas to be covered and the targets to be achieved and they break down as described below, bearing in mind that one of the objectives in the technology report is 'ensuring basic information technology competence in all teachers'. For those who read the interim report on design and technology it should be noted that the two areas of measurement and control and applications and effects have been moved into the general IT capability profile component. Thus, the topics of control, monitoring and associated activities can, theoretically be tackled in any area of the curriculum.

Any reading of the documents should bear in mind also that the information technology components have to be seen as part of a wider context.

Primary

For primary teachers the initial introductions to control technology comes through an understanding of the way in which one controls devices without microelectronics.

Thus pupils at levels 1 to 3 (ages five to seven) are expected to 'realise that control involves making things work as expected'.

So, for instance, computer-controlled toys may be used as well as studying everyday items such as cookers and telephones. Indeed the control of devices such as thermostats and videos are to be recommended as part of the programmes of study.

This is expanded at level 3 with the concept of inputs and outputs, the basic building blocks of control. For example, a footpump, cited in the technology report at this level, requires a certain input – foot pressure – in order to produce a certain output – air pressure.

At the ages of seven to 11, which is Key Stage 2, the pupil is expected to have developed a concept of procedures or 'sub-tasks' which are involved in the building of the total task. This is essentially considering the concept of programming – don't be put off if you've never done any.

Consider for instance the example used by the technology report – a set of computer controlled traffic lights. Where do you start? The first thing to decide is what is the end result? In this case it is to provide a system which will prevent cars travelling across a junction from two directions at once. What are the constraints? That one set of cars should stop whilst the other moves.

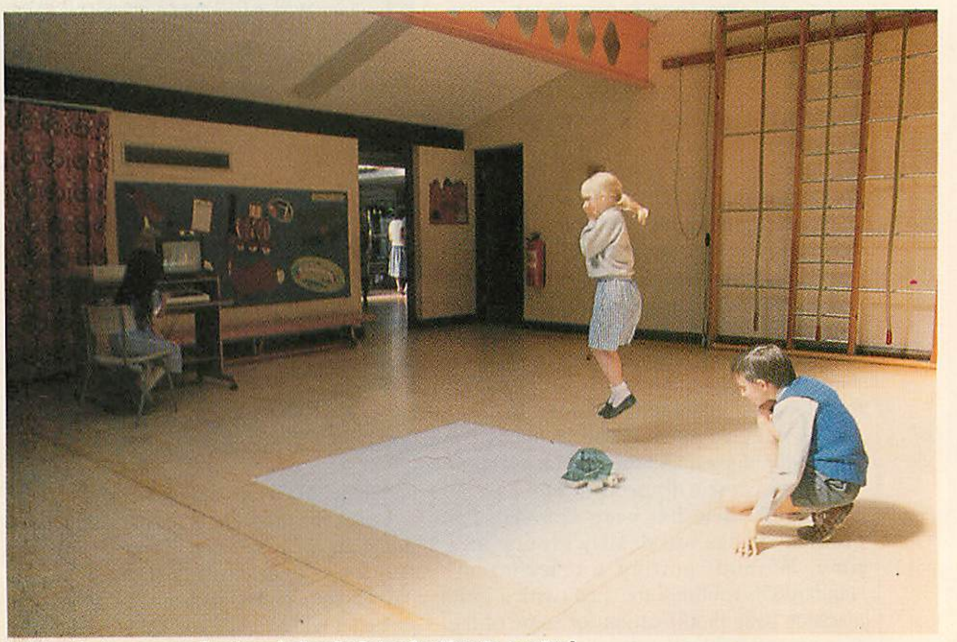
How do we achieve this? By making a set of lights which are red when the cars are to stop and green when they are to move. What additional constraints are there? That the cars should be warned with an amber light of a 'change of state'; that the system should be aware of queues of cars waiting; that there should be a fail-safe situation; that the instructions to the system should come in a particular order. From these facts it is possible to build up a set of procedures which result in the system being specified. The task then is to transfer that to a computer control device.

The system must then be evaluated for its efficiency, in line with Key Stage 2, level 4's specification that children should: 'Consider the efficiency of their system and whether modifications should be made to the design in order to improve it.'

Once you have done those tasks above, you will have achieved all the control technology criteria of the National Curriculum for primary education. However, it is not the time to stop and move on to something else. There are many computer-controlled solutions that can be applied throughout the primary school technology syllabus. Children should be encouraged to look at appropriate uses of the technology whenever it is relevant.

Secondary

In the secondary school much work will rely on the groundwork established in primaries. The first thing to say is that although there is little in the early stages of the secondary school's specification



The turtle is an excellent and simple introduction to control

CONTROL

involving control, it should not be ignored. For instance, the context at Key Stage 3 (age 11/12-14) in which it is suggested that flow charts be developed is prime ground for control technology work. Consider the definition of control below. Could you design a simple flow chart that fulfilled the need of our verbose buggy?

Control is really about putting stimulating outputs to control a device, taking inputs from other parts of the device to understand its present state and then modifying the inputs appropriately. This process is called 'feedback' and is simply making the computer react in the same way you would if you were controlling the device. The computer-controlled buggy is a good example of this. When its buffers hit a wall it can either sit there and wait for the next command, or you can program it so that it says,'Aha! I have hit something 'cos my bumper has been depressed, therefore I now go to the procedure called 'back-off-and-push-off'!

In the same way, all of the elements of planning, system analysis and the creation of planned solutions may be applied through control. More specifically, when one reaches Key Stage 4 (ages 14-16), pupils are required to: 'know how computer systems control machines and equipment', and 'use computers to design and make'.

The examples of a model lift, a car-park barrier and a burglar alarm are just that – examples. Local situations often throw up control problems which can be achieved in the context of the National Curriculum. For instance, how can we create a system which allows a severely physically disabled pupil to gain access to a store cupboard.

In the same key stage, the concept of feedback is formally introduced for the first time. It is likely to have raised its head informally well before this! Examples of a ball valve in a cistern and a central heating thermostat are cited but there are so many examples that can be created or studied in the context of everyday life that, once a little thought is applied, you'll wonder how you thought it was difficult!

Also at this level, the question of monitoring for its own sake and also as part of the feedback process is raised. Sensors may be used to measure temperature, light intensity, humidity or 'two state' situations where a sensor – usually a switch of some sort – is either on or off.

Monitoring the dampness of soil in a pot for example will allow the pupil to build a system for self-watering plants!

At level 9 pupils are expected to: 'design and implement systems in which control is maintained without the need for human intervention.'

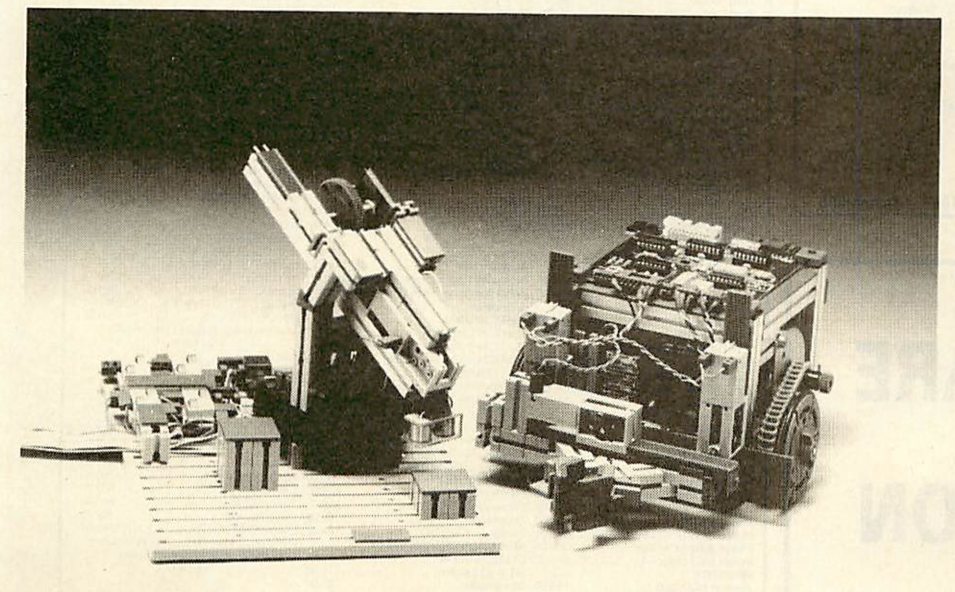
This is the opportunity for collaboration between science and technology in the creation, for example, of appropriate environments for different types of plants and animals. This builds on an earlier statement of attainment at level 5 where it is suggested that pupils might build an automatic watering system for a greenhouse. (It is worth noting that emphasis is laid in this example on representing the processes in symbolic form).

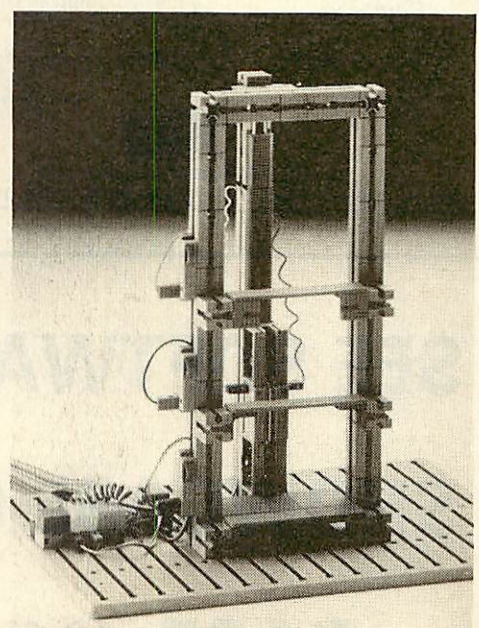
Also at Key Stage 4, pupils are expected to look at a range of data collection systems which are operated by computer. For instance, barcode readers, scanners and cash cards are excellent examples and, with a little ingenuity, can be emulated in the classroom. Questions of security, morality and associated issues are likely to be raised here – they are all part of the National Curriculum recommendations.

How do I do it? To 'do' control technology you must jump in head first. Don't be put off by the techies who will blind you with bits and bytes.

A parallel series of articles in *Educational Computing and Technology* is tackling the issues of control technology and offering constructive advice about which software and hardware is appropriate, which contexts it might be used in and the best ways to get the most out of your computer in response to the National Curriculum technology report.

BBC Acorn User would also be interested to hear of any control technology experiments or projects that your pupils have undertaken, whether successful or not. If you would like to share your experiences, then contact Nick Evans and Chris Drage at the *BBC Acorn User* address.





Familiarity with control technology puts a population at ease with a technology which increasingly permeates its lives

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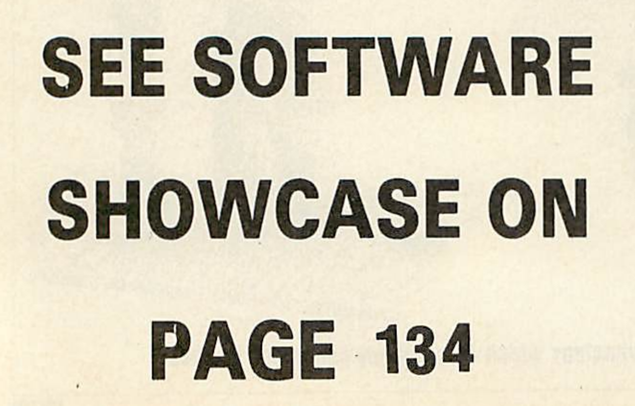
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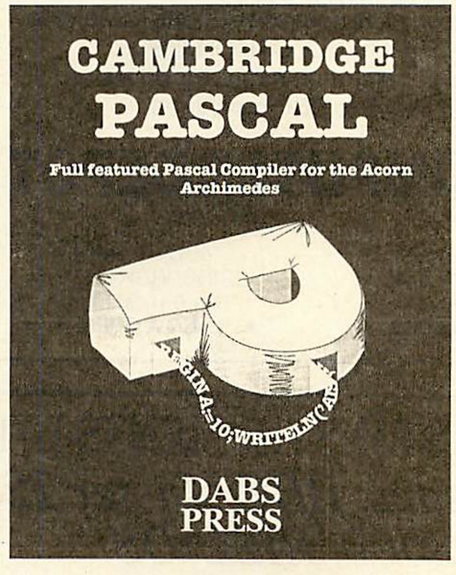
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Z88



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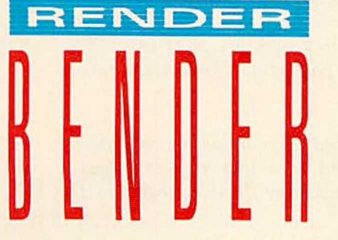


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We are not the only ones who think Impression is number one.

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"Overall Impression is a very powerful DTP package with a host of features. ...it is exceedingly easy to use, and produces excellent results, both on screen and on paper."

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"The latest and greatest in a fine tradition of word processors."

"Probably the most noticeable difference between the two packages is Impression's much greater speed. It is markedly faster.... and there is practically no waiting for sprite graphics to be drawn."

"A lot of thought has evidently gone into its philosophy and execution, and it is above all fast and powerful" Micro User Jan 1990.

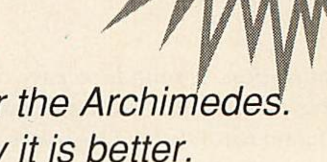
"I have used Pagemaker on the Mac, but there is just no comparison. Impression is so much better integrated from text entry to output management, more intuitive, faster and more flexible." Archive. Nov 1989

"I worked with a pre-release version of the program, but even this demonstrated extraordinary capabilities."

"...the most effective writing tool that I have yet handled."

"Impression is a world class document processor for a world class computer, and manages to be both powerful and friendly at the same time so that it is a real pleasure to use. I expect it to be even more successful on the Archimedes than Wordwise and Inter-Word have been on the ModelB/Master" Gordon Taylor. A&B Computing Dec 1989

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Impression, the document processor for the Archimedes. There are more than a few reasons why it is better.



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COMPATIBILITY

Program	Page	BBC B	B+/128	Master 128	Master Compact	Electron	Arc	6502SP/ Turbo	ADFS	Econet	Shadow RAM	Monthly Disc
Eight Bits	23											
Listing 1		■	■	■	■	■		■	■	■	■	■
Listing 2		■	■	■	■			■	■	■	■	■
Listing 3		■	■	■	■	■		■	■	■	■	■
Listing 4		■	■	■	■	■	■	■	■	■	■	■
Risc Revue	30											
Listings 1-5							■		■	■	■	■
AI	58											
Listings 1-3		■	■	■	■	■	■	■	■	■	■	■
Listing 4			■	■	■		■	■	■	■	■	■
Listing 5		■	■	■	■	■	■	■	■	■	■	■
Parsing	64											
Listings 1-3		■	■	■	■	■	■	■	■	■	■	■
Animals	73											
Listings 1-4							■		■	■	■	■
Disc Servicer	81											
Listing 1		■	■	■							■	■
COBOL (1)	75											
Listings 1-3		■	■	■	■			■	■	■	■	■

Note (1) requires last month's programs

EIGHT BITS

Listing 1

```
   10 REM Viewsheet File Joiner
   20 REM by Andrew Pillidge
   30 REM for B/B+/E/M/C
   40 REM (c) BAU Apr 90
   50 :
   60 MODE 4
   70 PROCbox(50,800,280)
   80 PROCbox(50,420,280)
   90 PROCbox(600,800,560)
  100 PRINTTAB(9,1)"VIEWSHEET File Joine
r"
  110 PRINTTAB(0,4)"First Viewsheet file
name ?"
  120 INPUTTAB(3,8)F1$
  130 PRINTTAB(0,4)"Second Viewsheet fil
ename ?"
  140 INPUTTAB(3,20)F2$
  150 PRINTTAB(0,4)"Name for new Viewshe
et File ?"
  160 INPUTTAB(20,8)F3$
  170 :
  180 F1=OPENIN F1$
  190 F2=OPENIN F2$
  200 :
  210 PTR#F1=303
  220 os1a=BGET#F1+BGET#F1*256
  230 os2a=BGET#F1+BGET#F1*256
  240 os3a=BGET#F1+BGET#F1*256
  250 top_a=BGET#F1+BGET#F1*256
  260 :
  270 PTR#F2=303
  280 os1b=BGET#F2+BGET#F2*256
  290 os2b=BGET#F2+BGET#F2*256
  300 os3b=BGET#F2+BGET#F2*256
  310 top_b=BGET#F2+BGET#F2*256
  320 :
  330 ds_a=os2a-os1a
  340 ds_b=os2b-os1b
  350 is_a=os3a-os2a
  360 is_b=os3b-os2b
  370 data_a=top_a-os3a
  380 data_b=top_b-os3b
  390 :
  400 PTR#F1=0
  410 PTR#F2=0
  420 rows=BGET#F1+BGET#F2
  430 IF rows>255 CLS:CLOSE#0:PRINT"Fina
l sheet will be too big":END
  440 :
  450 F3=OPENOUT F3$
  460 PTR#F1=0
  470 PTR#F3=0
  480 REPEAT
  490 byte=BGET#F1
  500 BPUT#F3,byte
  510 UNTIL PTR#F1=314
  520 :
  530 PTR#F3=0
  540 BPUT#F3,rows
  550 PTR#F3=303
  560 BPUT#F3,os1a MOD 256
  570 BPUT#F3,os1a DIV 256
  580 BPUT#F3,(os2a+ds_b)MOD 256
  590 BPUT#F3,(os2a+ds_b)DIV 256
  600 BPUT#F3,(os3a+os3b-os1b)MOD 256
  610 BPUT#F3,(os3a+os3b-os1b)DIV 256
  620 BPUT#F3,(top_a+top_b-os1b)MOD 256
  630 BPUT#F3,(top_a+top_b-os1b)DIV 256
  640 :
  650 PTR#F3=312+os1a
  660 PTR#F1=312+os1a
  670 PTR#F2=312+os1a
  680 :
  690 FOR N%=os1a TO os2a-1 STEP 3
  700 byte=BGET#F1
  710 BPUT#F3,byte
  720 pntr=BGET#F1+BGET#F1*256
  730 IF pntr<>0 THEN pntr=pntr+ds_b
  740 BPUT#F3,pntr MOD 256
  750 BPUT#F3,pntr DIV 256
  760 NEXT N%
  770 :
  780 FOR N%=os1b TO os2b-1 STEP 3
  790 byte=BGET#F2
  800 BPUT#F3,byte
  810 pntr=BGET#F2+BGET#F2*256
  820 IF pntr<>0 THEN pntr=pntr+ds_a+is_
a
  830 BPUT#F3,pntr MOD 256
  840 BPUT#F3,pntr DIV 256
  850 NEXT N%
  860 :
  870 FOR N%=0 TO is_a-1 STEP 2
  880 pntr=(BGET#F1)+(BGET#F1)*256
  890 IF pntr<>0 THEN pntr=pntr+is_b
  900 BPUT#F3,pntr MOD 256
  910 BPUT#F3,pntr DIV 256
  920 NEXT N%
  930 :
  940 FOR N%=0 TO is_b-1 STEP 2
  950 pntr=(BGET#F2)+(BGET#F2)*256
  960 IF pntr<>0 THEN pntr=pntr+data_a+i
s_a
  970 BPUT#F3,pntr MOD 256
  980 BPUT#F3,pntr DIV 256
  990 NEXT N%
 1000 :
 1010 FOR N%=0 TO data_a-1
 1020 byte=BGET#F1
 1030 BPUT#F3,byte
 1040 NEXT N%
 1050 :
 1060 FOR N%=0 TO data_b-1
 1070 byte=BGET#F2
 1080 BPUT#F3,byte
 1090 NEXT N%
 1100 :
 1110 CLOSE#0
 1120 END
 1130 :
 1140 DEF PROCbox(x,y,h)
 1150 MOVE x,y
 1160 DRAW x+400,y
 1170 DRAW x+400,y-h+40
 1180 DRAW x,y-h-40
 1190 DRAW x,y
 1200 ENDPROC
```

```
   10 REM *SPOOLON for the BBC
   20 REM by Joe Abley
   21 REM for BBC B/B+/E/M/C
   22 REM (c) BAU Apr 90
   40 :
   50 FOR pass=0 TO 2 STEP 2
   60 P%=&900
   70 [OPT pass
   80 :
   90 LDX #&70
  100 LDA #1
  110 LDY #0
  120 JSR &FFDA
  130 :
  140 LDY #0
  150 .loop
  160 LDA (&70),Y
  170 STA filename,Y
  180 INY
  190 CMP #13
  200 BNE loop
  210 :
  220 LDX #filename MOD &100
  230 LDY #filename DIV &100
  240 LDA #&C0
  250 JSR &FFCE
  260 CMP #0
  270 BNE spoolon
  280 LDX #spool MOD &100
  290 LDY #spool DIV &100
  300 JMP &FFF7
  310 :
  320 .spoolon
  330 STA handle
  340 LDA #2
  350 LDY handle
  360 LDX #&70
  370 JSR &FFDA
  380 LDA #1
  390 LDY handle
  400 LDX #&70
  410 JSR &FFDA
  420 :
  430 LDA #&C7
  440 LDX handle
  450 LDY #0
  460 JSR &FFF4
  470 :
  480 LDA #236
  490 LDX #0
  500 LDY #&FF
  510 JSR &FFF4
  520 TXA
  530 AND #&EF
  540 TAX
  550 LDA #236
  560 LDY #0
  570 JMP &FFF4
  580 :
  590 .handle
  600 EQUB 0
  610 .spool
  620 EQUS "SPOOL "
  630 .filename
  640 ]NEXT
  650 :
  660 DIM X% &100
  670 $X%="SAVE SPOOLON 900 "+STR$~P%+"
FFFF0900 FFFF0900"
  680 Y%=X% DIV &100
  690 CALL&FFF7
```

Listing 2

```
   10 REM BASIC Split Screen Utility
   20 REM by Stephen Double
   30 REM for BBC B/B+/M/C
   40 REM (c) BAU Apr 90
   50 :
   60 HIMEM=&3000
   70 DIM m%(1),vcr%(5),p%(15),tb%(1),gb
%(1),tt%(1),gt%(1)
   80 RESTORE 2260
   90 FOR x%=0 TO 5
  100 READ vcr%(x%)
  110 NEXT
  120 PROCassemble
  130 REM DEMO
  140 PROCsplit(1,1,16)
  150 FOR x%=0 TO 1
  160 FOR y%=0 TO 3
  170 PROCdefine(x%,y%,(x%*4)+y%)
  180 NEXT
  190 NEXT
  200 PROCopen(0)
  210 PRINT "8 COLOURS IN MODE 1:"
  220 PROCtriangles
  230 PROCdisable(1)
  240 PROCsplit(0,2,16)
  250 PROCopen(0)
  260 PRINT "TWO MODES:"
  270 PROCdefine(0,0,4)
  280 PROCtriangles
  290 PROCdisable(7)
  300 END
  310 :
  320 DEF PROCtriangles
  330 LOCAL x%,y%
  340 FOR x%=0 TO 1
  350 PROCopen(x%)
  360 FOR y%=1 TO 100
  370 GCOL 0,RND(7)
  380 PLOT 85,RND(1280),RND(1024)
  390 NEXT
  400 NEXT
  410 PROCopen(0)
  420 PRINT '"PRESS A KEY"
  430 x%=GET
  440 ENDPROC
  450 :
  460 DEF PROCassemble
  470 LOCAL x%
  480 FOR x%=0 TO 2 STEP 2
  490 P%=&900
  500 [
  510 OPT x%
  520 .time%
  530 BRK
  540 BRK
  550 BRK
```

Continued ▶

EIGHT BITS

◀ Continued

```
 560 BRK
 570 .vector%
 580 BRK
 590 BRK
 600 .vcr%
 610 BRK
 620 BRK
 630 .table%
 640 ]
 650 P%=P%+32
 660 [
 670 OPT x%
 680 .enable%
 690 SEI
 700 LDA &204
 710 STA vector%
 720 LDA &205
 730 STA vector%+1
 740 LDA #service% MOD 256
 750 STA &204
 760 LDA #service% DIV 256
 770 STA &205
 780 CLI
 790 LDA #189
 800 LDX #0
 810 LDY #0
 820 JSR &FFF4
 830 LDA &FE6B
 840 AND #&3F
 850 STA &FE6B
 860 RTS
 870 :
 880 .service%
 890 PHP
 900 PHA
 910 TXA
 920 PHA
 930 LDA &FE4D
 940 BPL servicea%
 950 AND #2
 960 BNE service1%
 970 .servicea%
 980 LDA &FE6D
 990 BPL servicex%
1000 AND #&40
1010 BNE service2%
1020 .servicex%
1030 PLA
1040 TAX
1050 PLA
1060 PLP
1070 JMP (vector%)
1080 .service1%
1090 LDA time%
1100 STA &FE64
1110 LDA time%+1
1120 STA &FE65
1130 LDA #&C0
1140 STA &FE6E
1150 LDA #1000 MOD 256
1160 STA &FE44
1170 LDA #1000 DIV 256
1180 STA &FE45
1190 LDA #10000 MOD 256
1200 STA &FE46
1210 LDA #10000 DIV 256
1220 STA &FE47
1230 LDA vcr%
1240 STA &FE20
1250 LDX #15
1260 .service1a%
1270 LDA table%,X
1280 STA &FE21
1290 DEX
1300 BPL service1a%
1310 JMP servicex%
1320 .service2%
1330 LDA vcr%+1
1340 STA &FE20
1350 LDX #15
1360 .service2a%
1370 LDA table%+16,X
1380 STA &FE21
1390 DEX
1400 BPL service2a%
1410 LDA #&40
1420 STA &FE6E
1430 JMP servicex%
1440 .disable%
1450 SEI
1460 LDA #&40
1470 STA &FE6E
1480 LDA vector%
1490 STA &204
1500 LDA vector%+1
1510 STA &205
1520 CLI
1530 LDA #22
1540 JSR &FFEE
1550 TYA
1560 JMP &FFEE
1570 ]
1580 NEXT
1590 ENDPROC
1600 :
1610 DEF PROCsplit(m0%,m1%,l%)
1620 LOCAL x%,y%
1630 m%(0)=m0%
1640 m%(1)=m1%
1650 ?vcr%=vcr%(m0%)
1660 vcr%?1=vcr%(m1%)
1670 !time%=1789+16384*(l%/32)
1680 tb%(0)=l%-1
1690 tt%(0)=0
1700 tb%(1)=31
1710 tt%(1)=l%
1720 FOR x%=0 TO 1
1730 gb%(x%)=992-(tb%(x%)*32)
1740 gt%(x%)=1023-(tt%(x%)*32)
1750 IF m%(x%)=0 OR m%(x%)=3 OR m%(x%)=
4 PROCdefine(x%,0,0):PROCdefine(x%,1,7)
1760 IF m%(x%)=1 OR m%(x%)=5 PROCdefine
(x%,0,0):PROCdefine(x%,1,1):PROCdefine(x
%,2,3):PROCdefine(x%,3,7)
1770 IF m%(x%)=2 FOR y%=0 TO 15:PROCdef
ine(x%,y%,y%):NEXT y%
1780 NEXT x%
1790 VDU 22,m0%
1800 CALL enable%
1810 ENDPROC
1820 :
1830 DEF PROCopen(s%)
1840 LOCAL c%
1850 RESTORE (2120+(m%(s%)*10))
1860 READ ?&34F,?&355,?&360,?&361,?&362
,?&363,c%
1870 VDU 28,0,tb%(s%),c%,tt%(s%)
1880 VDU 24,0;gb%(s%);1279;gt%(s%);
1890 ENDPROC
1900 :
1910 DEF PROCdefine(s%,lc%,pc%)
1920 LOCAL x%,b%
1930 RESTORE (2190+(m%(s%)*10))
1940 READ b%
1950 FOR x%=0 TO 15
1960 READ p%(x%)
1970 NEXT
1980 FOR x%=(lc%*b%) TO (lc%*b%)+b%-1
1990 ?(table%+x%+(s%*16))=p%(x%)+(pc% E
OR 7)
2000 NEXT
2010 ENDPROC
2020 :
2030 DEF PROCdisable(m%)
2040 Y%=m%
2050 CALL disable%
2060 ENDPROC
2070 :
2080 DEF FNadc(c%)
2090 ?&FEC0=c%-1
2100 =?&FEC1*256
2110 :
2120 DATA 8,0,1,7,&80,&01,79
2130 DATA 16,1,3,3,&88,&11,39
2140 DATA 32,2,15,1,&AA,&55,19
2150 DATA 8,0,1,7,&80,&01,79
2160 DATA 8,4,1,7,&80,&01,39
2170 DATA 16,5,3,3,&88,&11,19
2180 :
2190 DATA 8,0,&10,&20,&30,&40,&50,&60,&
70,&80,&90,&A0,&B0,&C0,&D0,&E0,&F0
2200 DATA 4,0,&10,&40,&50,&20,&30,&60,&
70,&80,&90,&C0,&D0,&A0,&B0,&E0,&F0
2210 DATA 1,0,&10,&20,&30,&40,&50,&60,&
70,&80,&90,&A0,&B0,&C0,&D0,&E0,&F0
2220 DATA 8,0,&10,&20,&30,&40,&50,&60,&
70,&80,&90,&A0,&B0,&C0,&D0,&E0,&F0
2230 DATA 8,0,&10,&20,&30,&40,&50,&60,&
70,&80,&90,&A0,&B0,&C0,&D0,&E0,&F0
2240 DATA 4,0,&10,&40,&50,&20,&30,&60,&
70,&80,&90,&C0,&D0,&A0,&B0,&E0,&F0
2250 :
2260 DATA &9C,&D8,&F4,&9C,&88,&C4
```

Listing 3

```
 10 REM April Fool
 20 REM by Jason O'Broin
 30 REM for B/B+/E/M/C
 40 REM (c) BAU Apr 90
 50 :
 60 oldvec=&F8
 70 wrchv=&20E
 80 break=&287
 90 FOR pass=0 TO 3 STEP 3
100 P%=&900
110 [OPT pass
120 .start
130 LDA #&4C
140 STA break
150 LDA #begin MOD 256
160 STA break+1
170 LDA #begin DIV 256
180 STA break+2
190 CLC
200 .begin
210 BCS no
220 LDA wrchv
230 STA oldvec
240 LDA wrchv+1
250 STA oldvec+1
260 LDA #entry MOD 256
270 STA wrchv
280 LDA #entry DIV 256
290 STA wrchv+1
300 .no
310 RTS
320 :
330 .entry
340 CMP #10
350 BEQ change
360 .out
370 JMP (oldvec)
380 .change
390 LDA #11
400 JMP out
410 ]
420 NEXT
430 CALL &900
```

Listing 4

```
 10 REM Easter Day Calculator
 20 REM by Jason O'Broin
 30 REM for B/B+/E/M/C/A
 40 REM (c) BAU Apr 90
 50 :
 60 PRINT''"Easter Day Calculator"
 70 INPUT'"Year 19"year
 80 B=year DIV 100
 90 C=year MOD 100
100 A=(5*B+C) MOD 19
110 D=(3*B+75) DIV 4
120 E=(3*B+75) MOD 4
130 F=(8*B+88) DIV 25
140 H=(19*A+D-F) MOD 30
150 G=(A+11*H) DIV 319
160 J=(60*(5-E)+C) DIV 4
170 K=(60*(5-E)+C) MOD 4
180 L=(2*J-K-H+G) MOD 7
190 N=(H-G+L+110) DIV 30
200 Q=(H-G+L+110) MOD 30
210 P=(Q+5-N) MOD 32
220 PRINT''"Easter day is on ";P;".";N
;".19";year
```

RISC REVUE

Listing 1

```
  10 REM >ScPresMod (RR1)
  20 REM Screen preserver (source)
  30 REM By Jason O'Broin
  40 REM for Archimedes only
  50 REM (c) BAU April 1990
  60 :
  70 DIM code 1000
  80 FOR pass%=4 TO 7 STEP 3
  90 P%=0
 100 O%=code
 110 [OPT pass%
 120 EQUD 0
 130 EQUD initcode
 140 EQUD finals
 150 EQUD service
 160 EQUD title
 170 EQUD help
 180 EQUD com
 190 :
 200 .initcode
 210 STMFD R13!,{R14}
 220 LDR R2,[R12]
 230 CMP R2,#0
 240 BNE fininit
 250 .init
 260 ADR R3,memneed
 270 LDR R3,[R3]
 280 MOV R0,#6
 290 SWI "XOS_Module"
 300 STR R2,[R12]
 310 .fininit
 320 MOV R0,#0
 330 STR R0,[R2]
 340 STR R0,[R2,#4]
 350 STR R0,[R2,#8]
 360 STR R0,[R2,#12]
 370 STR R0,[R2,#16]
 380 MOV R0,#&10
 390 ADR R1,event_handler
 400 SWI "XOS_Claim"
 410 MOV R0,#14
 420 MOV R1,#11
 430 SWI "XOS_Byte"
 440 MOV R1,#10
 450 SWI "XOS_Byte"
 460 MOV R1,#4
 470 SWI "XOS_Byte"
 480 LDMFD R13!,{PC}
 490 :
 500 .data
 510 EQUD 9000
 520 .memneed
 530 EQUD 24
 540 .mask
 550 EQUD 1<<10
 560 :
 570 .service
 580 STMFD R13!,{R14}
 590 CMP R1,#&27
 600 BEQ init
 610 LDMFD R13!,{PC}
 620 :
 630 .finals
 640 STMFD R13!,{R14}
 650 MOV R0,#13
 660 MOV R1,#11
 670 SWI "XOS_Byte"
 680 MOV R1,#10
 690 SWI "XOS_Byte"
 700 MOV R1,#4
 710 SWI "XOS_Byte"
 720 MOV R0,#&10
 730 ADR R1,event_handler
 740 LDR R2,[R12]
 750 SWI "XOS_Release"
 760 LDMFD R13!,{PC}
 770 :
 780 .die
 790 STMFD R13!,{R14}
 800 ADR R1,title
 810 MOV R0,#4
 820 SWI "XOS_Module"
 830 LDMFD R13!,{PC}
 840 :
 850 .settime
 860 STMFD R13!,{R14}
 870 CMP R1,#0
 880 MOV R2,#180
 890 BEQ storenew
 900 MOV R1,R0
 910 MOV R0,#10
 920 MOV R2,#1280
 930 SWI "XOS_ReadUnsigned"
 940 CMP R2,#0
 950 MOVEQ R2,#180
 960 .storenew
 970 MOV R3,#50
 980 MUL R1,R2,R3
 990 ADR R2,data
1000 STR R1,[R2]
1010 ADR R1,title
1020 MOV R0,#3
1030 SWI "XOS_Module"
1040 LDMFD R13!,{PC}
1050 :
1060 .event_handler
1070 STMFD R13!,{R0-R2,R8-R9,R12,R14}
1080 CMP R0,#11
1090 BEQ zero
1100 CMP R0,#10
1110 BEQ zero
1120 CMP R0,#4
1130 BEQ hz
1140 .out
1150 LDMFD R13!,{R0-R2,R8-R9,R12,PC}
1160 :
1170 .zero
1180 MOV R0,#0
1190 STR R0,[R12]
1200 LDR R1,[R12,#4]
1210 CMP R1,#1
1220 BNE out
1230 STR R0,[R12,#4]
1240 MOV R9,PC
1250 ORR R8,R9,#3
1260 TEQP R8,#0
1270 MOVNV R0,R0
1280 STMFD R13!,{R14}
1290 MOV R0,R1,LSL #10
1300 ADR R1,mask
1310 LDR R1,[R1]
1320 SWI "XOS_UpdateMEMC"
1330 ADD R1,R12,#8
1340 MOV R0,#&C
1350 SWI "XOS_Word"
1360 SWI &100+19
1370 SWI &100
1380 SWI &100+24
1390 LDR R0,[R12,#21]
1400 SWI "XOS_WriteC"
1410 SWI "XOS_WriteC"
1420 LDR R0,[R12,#23]
1430 SWI "XOS_WriteC"
1440 LDMFD R13!,{R14}
1450 TEQP R9,#0
1460 MOVNV R0,R0
1470 B out
1480 :
```

Continued ▶

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```
1490 .hz
1500 LDR RØ,[R12,#4]
1510 CMP RØ,#Ø
1520 BNE out
1530 LDR RØ,[R12]
1540 ADD RØ,RØ,#1
1550 STR RØ,[R12]
1560 ADR R1,data
1570 LDR R1,[R1]
1580 CMP R1,RØ
1590 BNE out
1600 .off
1610 MOV R9,PC
1620 ORR R8,R9,#3
1630 TEQP R8,#Ø
1640 MOVNV RØ,RØ
1650 STMFD R13!,{R14}
1660 MOV RØ,#Ø
1670 ADR R1,mask
1680 LDR R1,[R1]
1690 SWI "XOS_UpdateMEMC"
1700 ADD R1,R12,#8
1710 MOV RØ,#&B
1720 SWI "XOS_Word"
1730 ADD R1,R12,#13
1740 MOV RØ,#&C
1750 SWI "XOS_Word"
1760 MOV R1,#24
1770 SWI "XOS_ReadPalette"
1780 STR R2,[R12,#2Ø]
1790 SWI &1ØØ+19
1800 SWI &1ØØ
1810 SWI &1ØØ+24
1820 SWI &1ØØ
1830 SWI &1ØØ
1840 SWI &1ØØ
1850 LDMFD R13!,{R14}
1860 TEQP R9,#Ø
1870 MOVNV RØ,RØ
1880 MOV RØ,#1
1890 STR RØ,[R12,#4]
1900 B out
1910 :
1920 .title
1930 EQUS "ScreenPreserve"
1940 EQUB Ø
1950 ALIGN
1960 .help
1970 EQUS "Screen Preserve"
1980 EQUB 9
1990 EQUS "1.Ø5 (26 Jan 199Ø)"
2000 EQUB Ø
2010 ALIGN
2020 .com
2030 EQUS "ScPres"
2040 EQUB Ø
2050 ALIGN
2060 EQUD settime
2070 EQUD &ØØØ1FFØØ
2080 EQUD ht1syn
2090 EQUD ht1
2100 EQUS "NoScPres"
2110 EQUB Ø
2120 ALIGN
2130 EQUD die
2140 EQUD &ØØØØFFØØ
2150 EQUD ht2syn
2160 EQUD ht2
2170 EQUD Ø
2180 :
2190 .ht1
2200 EQUS "*ScPres causes the display t
o be switched off after a given period o
f keyboard/mouse inactivity."
2210 EQUB 13
2220 .ht1syn
2230 EQUS "Syntax: *ScPres <no. of seco
nds>"
2240 EQUB Ø
2250 ALIGN
2260 .ht2
2270 EQUS "*NoScPres kills off ScreenPr
eserve"
2280 EQUB 13
2290 .ht2syn
2300 EQUS "Syntax: *NoScPres"
2310 EQUB Ø
2320 EQUB Ø
2330 ]
2340 NEXT
2350 SYS "OS_File",1Ø,"ScPres",&FFA,,co
de,0%
2360 END
```

Listing 2

```
10 REM >HeapDemo1 (RR2)
20 REM HeapSort demonstration
30 REM by Dave Acton
40 REM for Archimedes only
50 REM (c) BAU April 199Ø
60 :
70 MODE Ø
80 objects%=1ØØØ
90 PRINT"Initialising..."'
100 DIM table% 4*objects%
110 FOR i%=Ø TO objects%-1
120 table%!(4*i%)=RND(1ØØØØØ)
130 NEXT
140 PRINT"Before:"
150 FOR i%=Ø TO objects%-1
160 PRINTi%;" : ";table%!(4*i%)
170 NEXT
180 TIME=Ø
190 SYS "OS_HeapSort",objects%,table%,
1
200 took%=TIME
210 PRINT"After:"
220 FOR i%=Ø TO objects%-1
230 PRINTi%;" : ";table%!(4*i%)
240 NEXT
250 PRINT"Time taken: ";took%/1ØØ;" se
cs"
260 END
```

Listing 3

```
10 REM >HeapDemo2 (RR3)
20 REM HeapSort demonstration
30 REM by Dave Acton
40 REM for Archimedes only
50 REM (c) BAU April 199Ø
60 :
70 MODE Ø
80 objects%=1ØØØ
90 PRINT"Initialising..."'
100 DIM table% 4*objects%
110 FOR i%=Ø TO objects%-1
120 len%=RND(1Ø)+1Ø
130 DIM a% len%+1
140 FOR j%=Ø TO len%-1
150 a%?j%=RND(26)+64
160 NEXT
170 a%?len%=13
180 table%!(4*i%)=a%
190 NEXT
200 PRINT"Before:"
210 FOR i%=Ø TO objects%-1
220 PRINTi%;" : ";$!(table%+4*i%)
230 NEXT
240 TIME=Ø
250 SYS "OS_HeapSort",objects%,table%,
4
260 took%=TIME
270 PRINT"After:"
280 FOR i%=Ø TO objects%-1
290 PRINTi%;" : ";$!(table%+4*i%)
300 NEXT
310 PRINT"Time taken: ";took%/1ØØ;" se
cs"
320 END
```

Listing 4

```
11 REM >NewDemLns (RR4)
80 DIM code 4ØØ
225 INPUT"Period (type 1): "period1%
226 INPUT"Period (type 2): "period2%
392 A%=Ø
393 next%=period1%
405 IF Q%=next% THEN
406 A%=1-A%
407 IF A%=1 next%+=period2% ELSE next%
+=period1%
408 ENDIF
695 MOV R9,RØ
805 CMP R9,#Ø
810 MOVEQ newrow,row
815 ADDNE newrow,row,#1
845 CMP R9,#Ø
850 MOVEQ newrow,row
855 SUBNE newrow,row,#1
875 CMP R9,#Ø
880 MOVEQ newcol,col
885 SUBNE newcol,col,#1
915 CMP R9,#Ø
920 MOVEQ newcol,col
925 ADDNE newcol,newcol,#1
```

Listing 5

```
10 REM >Automat (RR5)
20 REM Automaton
30 REM by Dave Acton
40 REM for Archimedes only
50 REM (c) BAU April 199Ø
60 :
70 MODE 13
80 ON ERROR IF ERR=17 AND NOT INKEY-1
 RUN ELSE MODE 12:PRINT REPORT$;" at lin
e ";ERL:END
90 DIM code% &1ØØØ,tab1% 16,tab2% 256
,ox%(2Ø),oy%(2Ø)
100 REPEAT
110 INPUT"Square size? (1-256) "lim%
120 UNTIL lim%>=1 AND lim%<=256
130 pairs%=Ø
140 REPEAT
150 PROCshowpairs
160 VDU 3Ø
170 PRINT"Enter offset ";pairs%+1
180 REPEAT
190 INPUT"x offset (-255 TO 255): "ox%
(pairs%)
200 UNTIL ox%(pairs%)>=-255 AND ox%(pa
irs%)<=255
210 REPEAT
220 INPUT"y offset (-255 TO 255): "oy%
(pairs%)
230 UNTIL oy%(pairs%)>=-255 AND oy%(pa
irs%)<=255
240 pairs%+=1
250 IF pairs%<2Ø PRINT"Another pair? (
Y/N)":k$=GET$ ELSE k$="N"
260 UNTIL k$<>"Y" AND k$<>"y"
270 OFF
280 !code%=149
290 code%!4=-1
300 SYS "OS_ReadVduVariables",code%,co
de%+8
310 screen%=code%!8
320 readbase=Ø:writebase=1
330 tab1=2:tab2=3
340 total=4:total2=5
350 order=6:wraddr=7
360 tx=8:new=8
370 ty=9:temp=9:byte=1Ø
380 x=11:y=12
390 sp=13:link=14:pc=15
400 FOR pass%=Ø TO 2 STEP 2
410 P%=code%
420 [OPT pass%
430 .generate
440 MOV y,#lim%-1
450 .yloop
460 MOV x,#lim%-1
470 ADD wraddr,writebase,y,ASL #8
480 ADD wraddr,wraddr,y,ASL #6
490 ADD wraddr,wraddr,x
500 .xloop
510 MOV total,#Ø
520 MOV total2,#Ø
530 ]
540 lastdx%=999
550 lastdy%=999
560 FOR i%=Ø TO pairs%-1
570 [OPT pass%
580 FNdo(ox%(i%),oy%(i%))
590 ]
600 NEXT i%
610 [OPT pass%
620 MOV total,total,LSR #1
630 AND new,total,#3
640 ADD new,new,tab1
650 AND byte,total2,#&FF
660 CMP total,byte
670 LDRLTB new,[new]
680 BLT change
690 AND byte,total2,#&FFØØ
700 CMP total,byte,LSR #8
710 LDRLTB new,[new,#4]
720 BLT change
730 AND byte,total2,#&FFØØØØ
740 CMP total,byte,LSR #16
750 LDRLTB new,[new,#8]
760 BLT change
770 CMP total,total2,LSR #24
780 LDRLTB new,[new,#12]
790 SUBGE byte,readbase,writebase
800 LDRGEB new,[wraddr,byte]
810 .change
820 STRB new,[wraddr],#-1
830 SUBS x,x,#1
840 BPL xloop
850 SUBS y,y,#1
860 BPL yloop
870 MOV pc,link
880 ]
890 NEXT pass%
900 FOR x%=Ø TO 15
910 READ k%
920 tab1%?x%=k%
930 tab2%?k%=x%
940 NEXT
950 PROCshowpairs
960 FOR x%=Ø TO lim%-1
970 FOR y%=Ø TO lim%-1
980 ?(screen%+x%+32Ø*y%)=tab1%?(RND(16
)-1)
990 NEXT
1000 NEXT
1010 *FX 112,2
1020 PROCshowpairs
1030 bank%=1
1040 gen%=Ø
1050 image%=Ø
1060 REPEAT
1070 PRINTTAB(33,29);gen%;
1080 WAIT
1090 SYS "OS_Byte",113,bank%
1100 SYS "OS_Byte",112,3-bank%
1110 A%=screen%+&14ØØØ*(bank%-1)
1120 B%=screen%+&14ØØØ*(2-bank%)
1130 C%=tab1%
1140 D%=tab2%
1150 CALL generate
1160 bank%=3-bank%
1170 gen%+=1
1180 UNTIL FALSE
1190 END
1200 :
1210 DEF PROCshowpairs
1220 CLS
1230 PRINTTAB(33,Ø)"Offsets"
1240 IF pairs%>Ø THEN
1250 FOR i%=Ø TO pairs%-1
1260 PRINTTAB(33,i%+2);ox%(i%);",";oy%(
i%)
1270 NEXT
1280 ENDIF
1290 ENDPROC
1300 :
1310 DEF FNdo(dx%,dy%)
1320 IF dx%<>lastdx% PROCcoord(tx,x,dx%
)
1330 IF dy%<>lastdy% PROCcoord(ty,y,dy%
)
1340 [OPT pass%
1350 ADD byte,readbase,ty,ASL #8
1360 ADD byte,byte,ty,ASL #6
1370 LDRB byte,[byte,tx]
1380 LDRB byte,[tab2,byte]
1390 AND order,byte,#%11
1400 ADD order,order,#1
1410 ADD total,total,order
1420 AND byte,byte,#%11ØØ
1430 MOV byte,byte,ASL #1
1440 ADD total2,total2,order,ASL byte
1450 ]
1460 lastdx%=dx%
1470 lastdy%=dy%
1480 =Ø
1490 :
1500 DEF PROCcoord(nr,r,off%)
1510 IF off%=Ø [OPT pass%:MOV nr,r:]
1520 IF off%>Ø [OPT pass%:ADD nr,r,#off
%:CMP nr,#lim%:SUBGE nr,nr,#lim%:]
1530 IF off%<Ø [OPT pass%:SUBS nr,r,#-o
ff%:MOVMI nr,#lim%-1:]
1540 ENDPROC
1550 :
1560 DATA 16,17,18,19,32,33,34,35,128,1
29,13Ø,131,192,193,194,195
```

ARTIFICIAL INTELLIGENCE

Listing 1

```
10 REM CAMISH1
20 REM by William Bains
30 REM for B/B+/M/C/E/A
40 REM (c) BAU April 199Ø
50 :
60 MODE 7
70 DIM river(5Ø,5)
80 INPUT "How many cannibals ";can,TA
B(6)"missionaries ";mish'
90 river(1,1)=can:river(1,2)=mish:riv
er(1,3)=Ø:river(1,4)=Ø:river(1,5)=Ø
100 FOR i=2 TO 3Ø:FOR j=1 TO 5:river(i
,j)=Ø:NEXT:NEXT
110 gotit=Ø:level=1:hit=Ø
120 GOSUB 22Ø
130 IF gotit=Ø THEN PRINT '"Failed! ":
END
140 FOR i=1 TO tlevel
150 PRINT "C=";river(i,1);", M=";river
(i,2);
160 q$="* //  "
170 IF river(i,5)=1 THEN q$="  // *"
180 PRINT q$;"C=";river(i,3);", M=";ri
ver(i,4)
190 NEXT
200 END
210 :
220 PRINT level;
230 IF river(level,1)=Ø THEN IF river(
level,2)=Ø THEN PRINT '"Got it!": tlevel
=level: gotit=1: RETURN
240 IF river(level,1)>river(level,2) T
HEN IF river(level,2)>Ø THEN RETURN
250 IF river(level,3)>river(level,4) T
HEN IF river(level,4)>Ø THEN RETURN
260 IF river(level,5)=1 THEN GOTO38Ø
270 IF river(level,1)=Ø THEN GOTO 31Ø
280 ia=-1: ib=-1: ic=1: id=1: ie=1: GO
SUB 5ØØ
```

Continued ▶

ARTIFICIAL INTELLIGENCE

◀ Continued

```
  290 level=level+1: GOSUB 220: level=level-1
  300 IF gotit=1 THEN RETURN
  310 ia=0: ib=-2: ic=0: id=2: ie=1: GOSUB 500
  320 level=level+1: GOSUB 220: level=level-1
  330 IF gotit=1 THEN RETURN
  340 ia=0: ib=-1: ic=0: id=1: ie=1: GOSUB 500
  350 level=level+1: GOSUB 220: level=level-1
  360 RETURN
  370 :
  380 ia=0: ib=1: ic=0: id=-1: ie=0: GOSUB 500
  390 level=level+1: GOSUB 220: level=level-1
  400 IF gotit=1 THEN RETURN
  410 IF river(level,4)<2 THEN GOTO 450
  420 ia=0: ib=2: ic=0: id=-2: ie=0: GOSUB 500
  430 level=level+1: GOSUB 220: level=level-1
  440 IF gotit=1 THEN RETURN
  450 IF river(level,3)=0 THEN RETURN
  460 ia=1: ib=1: ic=-1: id=-1: ie=0: GOSUB 500
  470 level=level+1: GOSUB 220: level=level-1
  480 RETURN
  490 :
  500 river((level+1),1)=river(level,1)+ia
  510 river((level+1),2)=river(level,2)+ib
  520 river((level+1),3)=river(level,3)+ic
  530 river((level+1),4)=river(level,4)+id
  540 river((level+1),5)=ie: RETURN
  550 :
  560 REM river(50,5)              = position
  570 REM river(x,1), river(x,3) = cannibals
  580 REM river(x,2), river(x,4) = missionaries
  590 REM river(x,5)              = 1 for boat right, 0 for boat left
  600 REM gotit                   = found solution
  610 REM level                   = layer of tree exploring (=x in river(x,1))
  620 REM tlevel                  = level reached
```

Listing 2

```
   10 REM CAMISH2
   20 REM by William Bains
   30 REM for B/B+/M/C/E/A
   40 REM (c) BAU April 1990
   50 :
   60 MODE 7
   70 DIM graph(6,500),state(6),nstate(6),lst(100,5)
   80 str=1:ff=1:INPUT "How many cannibals ";graph(1,1),TAB(6);"missionaries ";graph(2,1)'
   90 graph(3,1)=0:graph(4,1)=0:graph(5,1)=1:graph(6,1)=0:tot=1:cyc=1
  100 cyc=cyc+1:PRINT cyc;
  110 FOR now=str TO ff
  120 FOR i=1 TO 5:state(i)=graph(i,now):NEXT
  130 state(6)=now:boat=state(5):unboat=4-boat
  140 FOR i=1 TO 6:nstate(i)=state(i):NEXT
  150 nstate(boat+1)=state(boat+1)-1
  160 nstate(unboat+1)=nstate(unboat+1)+1
  170 GOSUB 360
  180 :
  190 IF state(boat+1)<2 THEN GOTO.250
  200 FOR i=1 TO 6:nstate(i)=state(i):NEXT
  210 nstate(boat+1)=state(boat+1)-2
  220 nstate(unboat+1)=state(unboat+1)+2
  230 GOSUB 360
  240 :
  250 IF state(boat)<1 THEN GOTO 330
  260 FOR i=1 TO 6:nstate(i)=state(i):NEXT
  270 nstate(boat+1)=state(boat+1)-1
  280 nstate(boat)=state(boat)-1
  290 nstate(unboat+1)=state(unboat+1)+1
  300 nstate(unboat)=state(unboat)+1
  310 GOSUB 360
  320 :
  330 NEXT
  340 IF tot=ff THEN PRINT '"Sorry - cannot be done":END
  350 str=ff+1:ff=tot:GOTO 100
  360 chk=0
  370 nstate(5)=unboat
  380 IF (nstate(2)-nstate(1))<0 THEN IF nstate(2)>0 THEN RETURN
  390 IF (nstate(4)-nstate(3))<0 THEN IF nstate(4)>0 THEN RETURN
  400 IF (nstate(1)+nstate(2))=0 THEN GOTO 450
  410 tot=tot+1
  420 FOR j=1 TO 6:graph(j,tot)=nstate(j):NEXT
  430 RETURN
  440 :
  450 FOR ll=1 TO 5:lst(1,ll)=nstate(ll):NEXT
  460 point=nstate(6):num=1
  470 num=num+1
  480 FOR ll=1 TO 5:lst(num,ll)=graph(ll,point):NEXT
  490 IF graph(6,point)=0 THEN GOTO 510
  500 point=graph(6,point):GOTO 470
  510 PRINT:FOR ll=num TO 1 STEP -1
  520 IF lst(ll,5)=3 THEN x$="  // *"
  530 IF lst(ll,5)=1 THEN x$="* //  "
  540 PRINT "C=";lst(ll,1); " M=";lst(ll,2);x$;"C=";lst(ll,3);" M=";lst(ll,4)
  550 NEXT
  560 END
  570 :
  580 REM graph(6,500) = game tree
  590 REM graph(1,x), graph(3,x) = number of cannibals on left and right
  600 REM graph(2,x), graph(4,x) = no. of missionaries
  610 REM graph(5,x) =1 for boat on left, 3 for boat on right
  620 REM graph(6,x) = "parent" state from which this position was derived
  630 REM graph(y,x) = position number x
  640 REM cyc = count of no. of levels searched
  650 REM tot = total no. of positions held in graph
  660 REM now = current position being extended
  670 REM boat = current position of boat
  680 REM unboat = position after this move
  690 REM state = current position
  700 REM nstate = position after the move.
```

Listing 3

```
    1 REM Extra lines for listing 2
    2 :
  371 j=0
  372 j=j+1
  373 chk=0
  374 FOR k=1 TO 5
  375 IF graph(k,j)<>nstate(k) THEN chk=chk+1
  376 NEXT
  377 IF chk=0 THEN RETURN
  378 IF j<tot THEN GOTO 372
```

Listing 4

```
   10 REM JET
   20 REM by William Bains
   30 REM for B+/M/C/A
   40 REM (c) BAU April 1990
   50 :
   60 DIM bord(40,80),target(21),ii(21),jj(21),v(21)
   70 FOR i=1 TO 19 STEP 2:target(i)=-1:target(i+1)=1:NEXT
   80 bl=40:bottom=3:MODE 7
   90 CLS:INPUT "How many pieces ";pc
  100 xx=INT(1+(bl-(1+pc*4))/2): IF xx<0 THEN xx=0
  110 FOR i=1 TO pc
  120 k=xx+RND(pc*4):IF bord(1,k)<>0 THEN GOTO 120
  130 bord(1,k)=1
  140 k=xx+RND(pc*4):IF bord(1,k)<>0 THEN GOTO 140
  150 bord(1,k)=-1
  160 NEXT
  170 :
  180 INPUT "Do you want to go first ";xx$
  190 k=1:CLS:GOSUB 550:IF xx$<>"y" THEN GOTO 300
  200 PRINT TAB(1,10);STRING$(20," ");TAB(1,10);"Your move ";
  210 INPUT xa,xb
  220 IF bord(1,xa)<>1 THEN PRINT "Invalid place: try again":GOTO 200
  230 d=-1:IF xb=1 THEN d=1
  240 bord(1,xa)=0:bord(1,(xa+d))=1:k=1:GOSUB 550:tl=1:GOSUB 660
  250 IF mtot>0 THEN GOTO 300
  260 PRINT "You win! "
  270 INPUT "Another game ";xx$:IF xx$="y" THEN FOR i=1 TO bl:bord(1,i)=0:NEXT:GOTO 90
  280 END
  290 :
  300 level=2:vx=0-pc
  310 FOR ix=1 TO bl
  320 IF bord(1,ix)<>-1 THEN GOTO 470
  330 FOR x=1 TO 0 STEP -1
  340 FOR jx=1 TO bl
  350 bord(2,jx)=bord(1,jx)
  360 NEXT
  370 d=-1:IF x=1 THEN d=1
  380 bord(2,(ix+d))=bord(2,ix):bord(2,ix)=0
  390 GOSUB 730
  400 :
  410 PRINT ".";
  420 IF v(2)>vx THEN vx=v(2):p=ix:m=x
  430 IF v(2)<>vx THEN GOTO 460
  440 IF ix>p THEN IF x=0 THEN p=ix:m=x
  450 IF ix<p THEN IF x=1 THEN p=ix:m=x
  460 NEXT
  470 NEXT
  480 d=1: IF m=0 THEN d=-1
  490 bord(1,(p+d))=bord(1,p):bord(1,p)=0
  500 k=1:GOSUB 550:tl=1:GOSUB 660
  510 PRINT "My move is ";p;",";m
  520 IF utot=0 THEN PRINT "I win!!":GOTO 270
  530 GOTO 200
  540 :
  550 PRINT TAB(1,0)
  560 FOR i=1 TO bl
  570 x$="."
  580 IF bord(k,i)=1 THEN x$="X"
  590 IF bord(k,i)=-1 THEN x$="O"
  600 PRINT x$;
  610 NEXT:PRINT
  620 FOR i=1 TO (bl/10):PRINT STRING$(9," ");"!";:NEXT
  630 PRINT
  640 FOR i=1 TO (bl/10):PRINT TAB((i*10)-2);(i*10);:NEXT
  650 PRINT:PRINT "You are X":RETURN
  660 mtot=0:utot=0
  670 FOR ii=1 TO bl
  680 IF bord(tl,ii)=1 THEN utot=utot+1
  690 IF bord(tl,ii)=-1 THEN mtot=mtot+1
  700 NEXT
  710 RETURN
  720 :
  730 ii(level)=0:v(level)=target(level)*pc
  740 ii(level)=ii(level)+1
  750 IF bord(level,ii(level))<>target(level) THEN GOTO 950
  760 jj(level)=0
  770 FOR k=1 TO bl:bord((level+1),k)=bord(level,k):NEXT
  780 d=-1:IF jj(level)=1 THEN d=1
  790 bord((level+1),(ii(level)+d))=bord((level+1),ii(level))
  800 bord((level+1),ii(level))=0
  810 tl=level+1:GOSUB 660
  820 IF utot=0 THEN v(level+1)=pc:RETURN
  830 IF mtot=0 THEN v(level+1)=0-pc:RETURN
  840 IF level=bottom THEN GOTO 890
  850 level=level+1
  860 GOSUB 730
  870 :
  880 level=level-1:GOTO 900
  890 v(level+1)=mtot-utot
  900 IF target(level)=-1 THEN GOTO 940
  910 IF v(level+1)<v(level) THEN v(level)=v(level+1)
  920 GOTO 950
  930 :
  940 IF v(level+1)>v(level) THEN v(level)=v(level+1)
  950 IF jj(level)=0 THEN jj(level)=1:GOTO 770
  960 IF ii(level)<bl THEN GOTO 740
  970 RETURN
  980 :
  990 REM board(x,y) = board squares (y) at current search level (x)
 1000 REM target(x) = market of whether level x is a MAX or a MIN level
 1010 REM v(x) = value of bord position at level x returned by the last call
 1020 REM pc = no. of pieces
 1030 REM bl = depth of search
 1040 :
 1050 REM How to play the game.
 1060 REM The board is displayed like this
 1070 REM ...X..O.X.XO...OX...
 1080 REM          !         !
 1090 REM         10        20
 1100 REM Specify a move by typing the number of the position of the piece
 1110 REM you want to move, and 0 for move_left, 1 for move_right. Thus 11,1
 1120 REM converts the board above to
 1130 REM ...X..O.X..X...OX...
```

Listing 5

```
   10 REM TICTAC
   20 REM by William Bains
   30 REM for B/B+/M/C/E/A
   40 REM (c) BAU April 1990
   50 :
   60 MODE 7
   70 DIM bord(25),bias(25),vl(25),hits(30,10)
   80 READ thit,nhit
   90 FOR i=1 TO 25:READ bias(i):NEXT
  100 FOR i=1 TO thit:FOR j=1 TO nhit:READ hits(i,j):NEXT:NEXT
  110 FOR i=1 TO 25:bord(i)=0:NEXT
  120 CLS:INPUT '"Shall I start ";y$
  130 IF y$<>"y" AND y$<>"Y" THEN GOTO 150
  140 GOSUB 320
  150 GOSUB 530
  160 :
  170 PRINT TAB(0,10)SPC(20):INPUT TAB(0,10)"What square ";s:PRINT TAB(0,9)SPC(30)
  180 IF bord(s)<>0 THEN PRINT TAB(0,9)"Square occupied - try again.":GOTO 150
  190 bord(s)=-1:GOSUB 530
  200 tst=-1:GOSUB 660
  210 IF ww=0 THEN GOTO 270
  220 IF ww=-1 THEN INPUT TAB(0,10)"It is a draw. Another game ";y$:GOTO 240
  230 INPUT TAB(0,10)"You win! Another game ";y$
  240 IF y$="y" OR y$="Y" THEN GOTO 110
  250 END
  260 :
  270 GOSUB 320: GOSUB 530
  280 tst=1:GOSUB 660
  290 IF ww=0 THEN GOTO 170
  300 IF ww=-1 THEN INPUT TAB(0,10)"A draw. Another game ";y$:GOTO 240
  310 INPUT TAB(0,10)"I win!! Another game ";y$:GOTO 240
  320 FOR x=1 TO 25:vl(x)=bias(x):NEXT
  330 PRINT STRING$(30," ")
  340 FOR x=1 TO thit
  350 tt=0: FOR z=1 TO nhit
  360 IF bord(hits(x,z))<>0 THEN tt=tt+ABS(bord(hits(x,z))-0.1)
  370 NEXT: IF tt=0 THEN GOTO 450
  380 t=1
  390 FOR y=1 TO (nhit-1)
  400 FOR z=(y+1) TO nhit
  410 IF ABS(bord(hits(x,y))-bord(hits(x,z)))=2 THEN t=0
  420 NEXT: NEXT
  430 IF t=0 THEN GOTO 450
  440 FOR z=1 TO nhit: vl(hits(x,z))=vl(hits(x,z))+tt: NEXT
  450 NEXT
  460 mx=-10
  470 FOR x=1 TO 25
  480 IF bord(x)=0 THEN IF vl(x)>mx THEN mx=vl(x): q=x
  490 NEXT
  500 bord(q)=1
  510 RETURN
  520 :
  530 PRINT TAB(0,2)
  540 FOR x=0 TO 4
  550 y$=""
  560 FOR y=1 TO 5
  570 IF bord(y+x*5)=1 THEN y$=y$+" x":GOTO 610
  580 IF bord(y+x*5)=-1 THEN y$=y$+" o": GOTO 610
  590 IF bord(y+x*5)=-2 THEN y$=y$+" X": GOTO 610
  600 y$=y$+" ."
  610 NEXT
  620 PRINT y$
  630 NEXT
  640 RETURN
  650 :
  660 ww=0:tt=0
  670 FOR x=1 TO 25
  680 IF bord(x)<>0 THEN tt=tt+1
  690 NEXT
  700 IF tt=25 THEN ww=-1:RETURN
  710 FOR x=1 TO thit
  720 tt=1
  730 FOR y=1 TO nhit
  740 IF bord(hits(x,y))<>tst THEN tt=0
  750 NEXT
  760 IF tt=1 THEN ww=1:q=x
  770 NEXT
  780 IF tst=-1 THEN RETURN
  790 IF ww=0 THEN RETURN
  800 FOR x=1 TC nhit:bord(hits(q,x))=-2:NEXT
  810 GOSUB 530
  820 RETURN
  830 :
  840 DATA 12,5
  850 DATA 0,0,0,0,0,0,0.25,0.25,0.25,0,0,0.25,1,0.25,0,0,0.25,0.25,0.25,0,0,0,0,0,0
  860 DATA 1,2,3,4,5
  870 DATA 6,7,8,9,10
  880 DATA 11,12,13,14,15
  890 DATA 16,17,18,19,20
  900 DATA 21,22,23,24,25
  910 DATA 1,6,11,16,21
  920 DATA 2,7,12,17,22
  930 DATA 3,8,13,18,23
  940 DATA 4,9,14,19,24
  950 DATA 5,10,15,20,25
```

Continued ▶

ARTIFICIAL INTELLIGENCE

◀ Continued

```
 960 DATA 1,7,13,19,25
 970 DATA 5,9,13,17,21
 980 :
 990 REM bord() = status of the board
1000 REM  -1 = a players piece (O), 1 =
 a computer piece (X)
1010 REM bias() = decides where to put
piece if rules are equal in outcome.
1020 REM vl() = value associated with p
utting piece in a given square
1030 :
1040 REM How to play the game.
1050 REM Squares are numbered left-to-r
ight, top-to-bottom, thus
1060 REM 1   2   3   4   5
1070 REM 6   7   8   9  10
1080 REM ...
1090 REM To make a move, type the squar
e number in which you want an X.
```

```
   1 REM these lines should replace lin
es 840 to 970 in TICTAC
   2 :
 840 DATA 9,8
 850 DATA 0,0,0,0,0,0,0.25,0.25,0.25,0,
0,0.25,1,0.25,0,0,0.25,0.25,0.25,0,0,0,0
,0,0
 860 DATA 1,2,3,8,13,12,11,6
 870 DATA 2,3,4,9,14,13,12,7
 880 DATA 3,4,5,10,15,14,13,8
 890 DATA 6,7,8,13,18,17,16,11
 900 DATA 7,8,9,14,19,18,17,12
 910 DATA 8,9,10,15,20,19,18,13
 920 DATA 11,12,13,18,23,22,21,16
 930 DATA 12,13,14,19,24,23,22,17
 940 DATA 13,14,15,20,25,24,23,18
 950 :
 960 :
 970 :
```

PARSING

Listing 1

```
  10 REM Parsing 1
  20 REM G Kendall
  30 REM for B/B+/M/C/E/A
  40 REM (c) BAU April 1990
  50 :
  60 MODE 4
  70 PROCinit
  80 PROCinput
  90 PROCvalid
 100 IF NOT verb_ind% OR NOT noun_ind%
THEN GOTO 80
 110 ON sub_rout% GOSUB 540,540,540
 120 GOTO 80
 130 :
 140 END
 150 :
 160 DEF PROCinit
 170 DIM verbs$(4,2),nouns$(4)
 180 no_verbs%=4
 190 no_nouns%=4
 200 verb_ind%=0
 210 noun_ind%=0
 220 FOR I%=1 TO no_verbs%
 230 FOR T%=1 TO 2
 240 READ verbs$(I%,T%)
 250 NEXT T%,I%
 260 FOR I%=1 TO no_nouns%
 270 READ nouns$(I%)
 280 NEXT I%
 290 ENDPROC
 300 :
 310 DEF PROCinput
 320 INPUT "What now",ans$
 330 IF ans$="" THEN PRINT "You must en
ter something":GOTO 320
 340 mkr%=INSTR(ans$," ")
 350 IF mkr%=0 THEN inp_verb$=ans$:noun
_ind%=-2:GOTO 380
 360 inp_verb$=LEFT$(ans$,mkr%-1)
 370 inp_noun$=RIGHT$(ans$,(LEN(ans$)-m
kr%))
 380 ENDPROC
 390 :
 400 DEF PROCvalid
 410 verb_ind%=0
 420 FOR I%=1 TO no_verbs%
 430 IF inp_verb$=verbs$(I%,1) THEN sub
_rout%=VAL(verbs$(I%,2)):verb_ind%=-1:I%
=no_verbs%
 440 NEXT
 450 IF NOT verb_ind% THEN PRINT "I'm s
orry I do not understand the word ";inp_
verb$:noun_ind%=0:GOTO 520
 460 IF noun_ind%=-2 THEN noun_ind%=-1:
GOTO 520
 470 noun_ind%=0
 480 FOR I%=1 TO no_nouns%
 490 IF inp_noun$=nouns$(I%) THEN noun_
number%=I%:noun_ind%=-1:I%=no_nouns%
 500 NEXT
 510 IF NOT noun_ind% THEN PRINT "I do
not know what a ";inp_noun$;" is"
 520 ENDPROC
 530 :
 540 REM This would contain the various
 verb subroutines
 550 PRINT "This would be a subroutine"
 560 RETURN
 570 :
 580 DATA "GET","1","KILL","2","GO","3"
,"NORTH","3"
 590 DATA "BOOK","DRAGON","AXE","COAT"
```

Listing 2

```
  10 REM Parsing 2
  20 REM by G Kendall
  30 REM for B/B+/M/C/E/A
  40 REM (c) BAU April 1990
  50 :
  60 PROCinit
  70 PROCinput
  80 PROCvalidinput
  90 PROCvalidverb
 100 IF ctr%>0 THEN PROCvalidnoun
 110 IF NOT verb_ind% OR NOT noun_ind%
THEN GOTO 70
 120 ON sub_rout% GOSUB 840,840,840
 130 GOTO 70
 140 END
 150 :
 160 DEF PROCinit
 170 DIM verbs$(4,3),nouns$(4),inp_noun
s$(50),elims$(50)
 180 no_verbs%=4
 190 no_nouns%=4
 200 no_elims%=3
 210 verb_ind%=0
 220 noun_ind%=0
 230 elim_ind%=0
 240 FOR I%=1 TO no_verbs%
 250 FOR T%=1 TO 2
 260 READ verbs$(I%,T%)
 270 NEXT T%,I%
 280 FOR I%=1 TO no_nouns%
 290 READ nouns$(I%)
 300 NEXT I%
 310 FOR I%=1 TO no_elims%
 320 READ elims$(I%)
 330 NEXT I%
 340 ENDPROC
 350 :
 360 DEF PROCinput
 370 INPUT "What now",ans$
 380 IF ans$="" THEN PRINT "You must en
ter something":GOTO 370
 390 ENDPROC
 400 :
 410 DEF PROCvalidinput
 420 verb_ind%=0
 430 ctr%=0
 440 mkr%=INSTR(ans$," ")
 450 IF mkr%=0 THEN inp_verb$=ans$:GOTO
 560
 460 inp_verb$=LEFT$(ans$,mkr%-1)
 470 ans$=RIGHT$(ans$,(LEN(ans$)-mkr%))
 480 REPEAT
 490 ctr%=ctr%+1
 500 mkr%=INSTR(ans$," ")
 510 IF mkr%=0 THEN inp_nouns$(ctr%)=an
s$ ELSE inp_nouns$(ctr%)=LEFT$(ans$,mkr%
-1)
 520 PROCelim(inp_nouns$(ctr%))
 530 IF elim_ind% THEN ctr%=ctr%-1
 540 ans$=RIGHT$(ans$,(LEN(ans$)-mkr%))
 550 UNTIL mkr%=0
 560 ENDPROC
 570 :
 580 DEF PROCvalidverb
 590 FOR I%=1 TO no_verbs%
 600 IF inp_verb$=verbs$(I%,1) THEN sub
_rout%=VAL(verbs$(I%,2)):verb_ind%=-1:I%
=no_verbs%
 610 NEXT
 620 IF NOT verb_ind% THEN PRINT "I'm s
orry, I do not understand the word ";inp
_verb$
 630 ENDPROC
 640 :
 650 DEF PROCvalidnoun
 660 noun_ind%=-1
 670 FOR I%=1 TO ctr%
 680 temp_ind%=0
 690 FOR P%=1 TO no_nouns%
 700 IF inp_nouns$(I%)=nouns$(P%) THEN
temp_ind%=-1:P%=no_nouns%
 710 NEXT P%
 720 IF NOT temp_ind% THEN PRINT "Sorry
 I do not know what a ";inp_nouns$(I%);"
 is":noun_ind%=0
 730 NEXT I%
 740 ENDPROC
 750 :
 760 DEF PROCelim(word$)
 770 LOCAL I%
 780 elim_ind%=0
 790 FOR I%=1 TO no_elims%
 800 IF word$=elims$(I%) THEN elim_ind%
=-1:I%=no_elims%
 810 NEXT I%
 820 ENDPROC
 830 :
 840 REM This would contain the various
 verb subroutines
 850 PRINT "Subroutine value = ";sub_ro
ut%
 860 PRINT "Nouns passed to it are :- "
 870 IF ctr%=0 THEN GOTO 910
 880 FOR I%=1 TO ctr%
 890 PRINT inp_nouns$(I%)
 900 NEXT
 910 RETURN
 920 :
 930 DATA "GET","1","KILL","2","GO","3"
,"NORTH","3"
 940 DATA "BOOK","DRAGON","AXE","COAT"
 950 DATA "AND","THE","WITH"
```

Listing 3

```
  10 REM Parsing 3
  20 REM by G Kendall
  30 REM for B/B+/M/C/E/A
  40 REM (c) BAU April 1990
  50 :
  60 MODE 4
  70 PROCinit
  80 PROCinput
  90 PROCremovepunctuation
 100 PROCdeleterubbish
 110 PROCreplacepronouns
 120 PROCseperateactions
 130 PROCorderactions
 140 PROCdisplayactions
 150 GOTO 80
 160 END
 170 :
 180 DEF PROCinit
 190 verb%=6
 200 noun%=5
 210 speech%=1
 220 male%=1
 230 rubbish%=6
 240 punc%=2
 250 pronoun%=3
 260 replace%=2
 270 seq%=1
 280 DIM verb$(verb%),noun$(noun%),spee
ch$(speech%),male$(male%),rubbish$(rubbi
sh%),punc$(punc%),pronoun$(pronoun%,2),s
eq$(seq%),temp_array$(10),action$(11),ac
t_ptr%(11)
 290 FOR I%=1 TO verb%
 300 READ verb$(I%)
 310 NEXT I%
 320 FOR I%=1 TO noun%
 330 READ noun$(I%)
 340 NEXT I%
 350 FOR I%=1 TO speech%
 360 READ speech$(I%)
 370 NEXT I%
 380 FOR I%=1 TO male%
 390 READ male$(I%)
 400 NEXT I%
 410 FOR I%=1 TO rubbish%
 420 READ rubbish$(I%)
 430 NEXT I%
 440 FOR I%=1 TO punc%
 450 READ punc$(I%)
 460 NEXT I%
 470 FOR I%=1 TO pronoun%
 480 FOR P%=1 TO 2
 490 READ pronoun$(I%,P%)
 500 NEXT P%,I%
 510 FOR I%=1 TO seq%
 520 READ seq$(I%)
 530 NEXT I%
 540 ENDPROC
 550 DEF PROCinput
 560 inp$=""
 570 INPUT LINE "What now";inp$
 580 IF inp$="" THEN PRINT "You must en
ter something":GOTO 570 ELSE inp$=inp$ +
 " "
 590 ENDPROC
 600 :
 610 DEF PROCremovepunctuation
 620 temp$=""
 630 FOR I%=1 TO LEN(inp$)
 640 ind%=0
 650 FOR P%=1 TO punc%
 660 IF MID$(inp$,I%,1)=punc$(P%) THEN
ind%=-1
 670 NEXT P%
 680 IF NOT ind% THEN temp$=temp$ + MID
$(inp$,I%,1)
 690 NEXT I%
 700 inp$=temp$
 710 ENDPROC
 720 :
 730 DEF PROCdeleterubbish
 740 FOR I%=1 TO rubbish%
 750 REPEAT
 760 P%=INSTR(inp$,rubbish$(I%))
 770 IF P%=0 THEN GOTO 800
 780 temp$=LEFT$(inp$,P%)
 790 inp$=temp$ + RIGHT$(inp$,((LEN(inp
$)+1)-(P% + LEN(rubbish$(I%)))))
 800 UNTIL P%=0
 810 NEXT I%
 820 ENDPROC
 830 :
 840 DEF PROCreplacepronouns
 850 E%=0
 860 REPEAT
 870 FOR I%=1 TO pronoun%
 880 P%=INSTR(inp$,pronoun$(I%,1))
 890 IF P%=0 THEN E%=E% +1:GOTO 1040
 900 ON VAL(pronoun$(I%,2)) GOSUB 1510,
1580
 910 R%=0:H%=0
 920 FOR L%=1 TO K%
 930 X%=INSTR(inp$,temp_array$(L%))
 940 IF X%=0 THEN H%=H% +1:GOTO 960
 950 IF (X% < P%) AND (X% > R%) THEN R%
=X%:F%=L%
 960 NEXT L%
 970 IF H%=K% THEN ind%=0 ELSE ind%=-1
 980 IF NOT ind% THEN PRINT "I'm sorry,
 I cannot make sense of this":GOTO 1060
 990 temp$=LEFT$(inp$,P%)
1000 temp$=temp$ + temp_array$(F%) + "
"
1010 temp1$=RIGHT$(inp$,(LEN(inp$)-P%))
1020 T%=INSTR(temp1$," ")
1030 IF T%=0 THEN inp$=temp$ ELSE inp$=
temp$ + RIGHT$(temp1$,LEN(temp1$)-T%)
1040 NEXT I%
1050 IF E%=pronoun% THEN ind%=-1
1060 ENDPROC
1070 :
1080 DEF PROCseperateactions
1090 FOR I%=1 TO 11:action$(I%)="":NEXT
1100 X%=1
1110 FOR I%=1 TO 11:act_ptr%(I%)=999:NE
XT
1120 FOR I%=1 TO verb%
1130 T%=INSTR(inp$,verb$(I%))
1140 IF T%=0 THEN GOTO 1160
1150 act_ptr%(X%)=T%:X%=X% +1
1160 NEXT I%
1170 sorted%=-1
1180 FOR I%=1 TO 10
1190 IF act_ptr%(I%) > act_ptr%(I%+1) T
HEN TEMP%=act_ptr%(I%):act_ptr%(I%)=act_
ptr%(I%+1):act_ptr%(I%+1)=TEMP%:sorted%=
0
1200 NEXT I%
1210 IF NOT sorted% THEN GOTO 1170
1220 IF act_ptr%(1)=999 THEN action$(1)
=inp$
1230 FOR I%=1 TO 10
1240 IF act_ptr%(I%)=999 THEN I%=10:GOT
O 1260
1250 action$(I%)=MID$(inp$,act_ptr%(I%)
,((act_ptr%(I%+1)-1)-act_ptr%(I%)))
1260 NEXT I%
1270 ENDPROC
1280 :
1290 DEF PROCorderactions
1300 FOR I%=1 TO 11:act_ptr%(I%)=-1:NEX
T
1310 FOR I%=1 TO 10
1320 IF action$(I%)="" THEN I%=10:GOTO
1390
1330 FOR L%=1 TO seq%
1340 T% =INSTR(action$(I%),seq$(L%))
1350 IF T%=0 THEN act_ptr%(I%)=I%:GOTO
1380
1360 action$(I%)=MID$(action$(I%),1,T%-
1)
1370 IF L%=1 THEN act_ptr%(I%)=I%+1:act
_ptr%(I%+1)=I%:I%=I%+1
1380 NEXT L%
1390 NEXT I%
1400 ENDPROC
1410 :
1420 DEF PROCdisplayactions
1430 PRINT:PRINT "Actions will be carri
ed out as follows"
1440 PRINT "=============================
============":PRINT
1450 FOR I%=1 TO 10
1460 IF act_ptr%(I%)=-1 THEN I%=10:GOTO
 1480
1470 PRINT action$(act_ptr%(I%))
```

Continued ▶

PARSING

◀ Continued

```
1480 NEXT I%
1490 ENDPROC
1500 :
1510 REM SUBROUTINE TO COPY MALE ARRAY TO TEMP ARRAY
1520 FOR K%=1 TO male%
1530 temp_array$(K%)=male$(K%)
1540 NEXT K%
1550 K%=K%-1
1560 RETURN
1570 :
1580 REM SUBROUTINE TO COPY NOUN ARRAY TO TEMP ARRAY
1590 FOR K%=1 TO noun%
1600 temp_array$(K%)=noun$(K%)
1610 NEXT K%
1620 K%=K%-1
1630 RETURN
1640 :
1650 DATA HIT,SAY,GET,FILL,EATING,GO
1660 DATA BRICK,SOUTH,BOTTLE,WATER,FOOD
1670 DATA HELLO
1680 DATA ROGER
1690 DATA " TO "," AND "," THEN "," WITH ", " THE "," SOME "
1700 DATA ",",","."
1710 DATA " HIM ",1," IT ",2," THEM ",2
1720 DATA AFTER
```

ANIMALS

Listing 1

```
10 REM >AI-Pool
20 REM By David Lawrence
30 REM For Archimedes only
40 REM (c) BAU 1990
50 :
60 ON ERROR PROCerror
70 MODE 12
80 PROCinit
90 PROCload
100 REPEAT
110   PROCguess
120 UNTIL FALSE
130 END
140 :
150 DEF PROCerror
160 IF ERR = 17 THEN
170   ON ERROR IF ERR = 17 MODE 12:END ELSE PRINT REPORT$;" at line ";ERL
180   IF NOT INKEY-2 PROCsave
190   MODE 12
200 ELSE
210   PRINT REPORT$;" at line ";ERL
220 ENDIF
230 END
240 :
250 DEF PROCinit
260 total = HIMEM - END - &8000
270 DIM mem total
280 SYS "OS_Heap",0,mem,,total
290 COLOUR 8,&F0,&C0,0
300 :
310 defname$ = "PoolData"
320 :
330 Null  = 0
340 False = 0
350 True  = 1
360 :
370 firstq = Null
380 firsto = Null
390 lastq  = Null
400 lasto  = Null
410 :
420 Question = 0
430 Option   = 4
440 Answer   = 0
450 Object   = 4
460 :
470 Qstflag  = 8
480 Qsttext  = 9
490 :
500 Optlink  = 8
510 Opttext  = 12
520 :
530 Objnext  = 0
540 Objcount = 4
550 Objflag  = 8
560 Objtext  = 9
570 :
580 ans_size = 8
590 ENDPROC
600 :
610 DEF FNfile(text$)
620 CLS
630 COLOUR 7
640 PRINT ''"Enter filename to ";text$;" [";defname$;"] : ";
650 INPUT ""name$
660 IF name$ = "" AND defname$ <> "" THEN name$ = defname$
670 =name$
680 :
690 DEF PROCsave
700 name$ = FNfile("save")
710 file% = OPENOUT(name$)
720 PROCsave_objects(firsto)
730 PROCsave_quests(firstq)
740 CLOSE #file%
750 ENDPROC
760 :
770 DEF PROCsave_objects(addr)
780 REPEAT
790   BPUT #file%,$(addr+Objtext)
800   addr = addr!Objnext
810 UNTIL addr = Null
820   BPUT #file%,10
830 ENDPROC
840 :
850 DEF PROCsave_quests(addr)
860 REPEAT
870   BPUT #file%,"?"+$(addr+Qsttext)
880   opt = addr!Option
890   REPEAT
900     BPUT #file%,">"+$(opt+Opttext)
910     ans = opt!Answer
920     WHILE ans <> Null
930       obj = ans!Object
940       BPUT #file%," "+$((ans!Object)+Objtext)
950       ans = ans!Answer
960     ENDWHILE
970     opt = opt!Option
980   UNTIL opt = Null
990   addr = addr!Question
1000 UNTIL addr = Null
1010 ENDPROC
1020 :
1030 DEF PROCload
1040 name$ = FNfile("load")
1050 defname$ = name$
1060 file% = OPENIN(name$)
1070 PROCload_objects
1080 PROCload_quests
1090 CLOSE #file%
1100 CLS
1110 ENDPROC
1120 :
1130 DEF PROCload_objects
1140 REPEAT
1150   obj$ = GET$#file%
1160   IF obj$ <> "" THEN
1170     obj_ptr = FNadd_object(obj$)
1180   ENDIF
1190 UNTIL obj$ = ""
1200 ENDPROC
1210 :
1220 DEF PROCload_quests
1230 REPEAT
1240   line$ = GET$#file%
1250   text$ = MID$(line$,2)
1260   CASE LEFT$(line$,1) OF
1270     WHEN "?" :
1280       qst_ptr = FNadd_question(text$)
1290     WHEN ">" :
1300       opt_ptr = FNadd_option(text$,qst_ptr)
1310     WHEN " " :
1320       obj_ptr = FNexists(firsto,text$)
1330       ans_ptr = FNadd_answer(obj_ptr,opt_ptr)
1340   ENDCASE
1350 UNTIL EOF #file%
1360 ENDPROC
1370 :
1380 DEF FNadd_question(text$)
1390 ptr = FNtalloc(text$,Qsttext)
1400 ptr!Question = Null
1410 ptr!Option   = Null
1420 ptr?Qstflag  = True
1430 IF firstq = Null THEN
1440   firstq = ptr
1450 ELSE
1460   lastq!Question = ptr
1470 ENDIF
1480 lastq = ptr
1490 = ptr
1500 :
1510 DEF FNadd_option(text$,qst)
1520 ptr = FNtalloc(text$,Opttext)
1530 ptr!Answer  = Null
1540 ptr!Option  = Null
1550 ptr!Optlink = Null
1560 !FNappend(qst,Option) = ptr
1570 = ptr
1580 :
1590 DEF FNadd_answer(obj_addr,opt)
1600 ptr = FNalloc(ans_size)
1610 ptr!Answer = Null
1620 ptr!Object = obj_addr
1630 !FNappend(opt,Answer) = ptr
1640 = ptr
1650 :
1660 DEF FNadd_object(text$)
1670 ptr = FNtalloc(text$,Objtext)
1680 ptr!Objcount = 0
1690 ptr!Objnext  = Null
1700 ptr?Objflag  = True
1710 IF firsto = Null THEN
1720   firsto = ptr
1730 ELSE
1740   lasto!Objnext = ptr
1750 ENDIF
1760 lasto = ptr
1770 = ptr
1780 :
1790 DEF FNappend(addr,offset)
1800 WHILE addr!offset <> Null
1810   addr = addr!offset
1820 ENDWHILE
1830 = addr + offset
1840 :
1850 DEF FNtalloc(t$,size)
1860 txt = FNalloc(size+LENt$+1)
1870 $(txt+size) = t$
1880 =txt
1890 :
1900 DEF FNalloc(size)
1910 SYS "OS_Heap",2,mem,,size TO ,,addr
1920 IF addr>0 THEN =addr
1930 PRINT"Failed to allocate"
1940 END
1950 :
1960 DEF FNreset(addr,noff,foff,flag)
1970 total = 0
1980 REPEAT
1990   addr?foff = True
2000   IF flag addr!Objcount = 0
2010   total += 1
2020   addr = addr!noff
2030 UNTIL addr = Null
2040 = total
2050 :
2060 DEF FNsd(addr)
2070 sumx  = 0
2080 sumxx = 0
2090 unknown = objects
2100 n = 1
2110 opt = addr!Option
2120 REPEAT
2130   n += 1
2140   x = 0
2150   ans = opt!Answer
2160   REPEAT
2170     obj = ans!Object
2180     IF obj?Objflag = True THEN
2190       x += 1
2200       unknown -= 1
2210     ENDIF
2220     ans = ans!Answer
2230   UNTIL ans = Null
2240   opt = opt!Option
2250   sumx  += x
2260   sumxx += (x^2)
2270 UNTIL opt = Null
2280 sumx += unknown
2290 sumxx += (unknown^2)
2300 var = sumxx/n - (sumx/n)^2
2310 sd = SQR(var)
2320 = sd
2330 :
2340 DEF FNchoose(qptr)
2350 best  = Null
2360 lowsd = 1E38
2370 lounk = 1E38
2380 REPEAT
2390   IF qptr?Qstflag = True THEN
2400     sd = FNsd(qptr)
2410     IF sd < lowsd OR (sd = lowsd AND unknown <= lounk) THEN
2420       lowsd = sd
2430       lounk = unknown
2440       best  = qptr
2450     ENDIF
2460   ENDIF
2470   qptr = qptr!Question
2480 UNTIL qptr = Null
2490 = best
2500 :
2510 DEF PROCremove(addr)
2520 addr?Qstflag = False
2530 quests -= 1
2540 ENDPROC
2550 :
2560 DEF FNshow_question(addr)
2570 text$ = $(addr+Qsttext)
2580 COLOUR 3
2590 PRINT''text$'STRING$(LENtext$,"-")'
2600 opt$ = ""
2610 opt  = addr!Option
2620 num  = 1
2630 REPEAT
2640   let$ = CHR$(64+num)
2650   COLOUR 1
2660   PRINT "  ";let$;") ";
2670   COLOUR 2
2680   PRINT $(opt+Opttext)
2690   opt = opt!Option
2700   opt$ += let$
2710   num += 1
2720 UNTIL opt = Null
2730 COLOUR 7
2740 PRINT'"Select answer (A";
2750 IF let$ <> "A" THEN PRINT "-";let$;
2760 PRINT ", ? for new option or Return to ignore) : ";
2770 = CHR$13 + "?" + opt$
2780 :
2790 DEF FNinput(prompt$,minlen)
2800 COLOUR 3
2810 PRINT 'prompt$
2820 COLOUR 7
2830 PRINT " : ";
2840 COLOUR 2
2850 in$ = ""
2860 REPEAT
2870   key = GET
2880   IF key > 31 AND key < 127 AND LENin$ < 255 in$ += CHR$key : VDU key
2890   IF key = 127 AND in$ <> "" in$ = LEFT$(in$) : VDU 127
2900 UNTIL key = 13 AND LENin$ >= minlen
2910 PRINT
2920 = in$
2930 :
2940 DEF FNisita(obj)
2950 COLOUR 8
2960 PRINT'" - Is it ";$(obj+Objtext);"? ";
2970 itis = FNget_key("nNyY") DIV 2
2980 IF NOT itis THEN
2990   obj?Objflag = False
3000   objects -= 1
3010 ENDIF
3020 = itis
3030 :
3040 DEF FNget_key(range$)
3050 REPEAT
3060   key$ = GET$
3070   IF key$ >= "a" AND key$ <= "z" key$ = CHR$(ASCkey$ - 32)
3080   key = INSTR(range$,key$)
3090 UNTIL key > 0
3100 COLOUR 2
3110 PRINT key$
3120 = key - 1
3130 :
3140 DEF FNoptaddr(addr,num)
3150 FOR i = 1 TO num
3160   addr = addr!Option
3170 NEXT
3180 = addr
3190 :
3200 DEF FNcount(opt)
3210 total = 0
3220 ans = opt!Answer
3230 REPEAT
3240   obj = ans!Object
3250   IF obj?Objflag = True THEN
3260     obj!Objcount += 1
3270     total += 1
3280     objptr = obj
3290   ENDIF
3300   ans = ans!Answer
3310 UNTIL ans = Null
3320 = total
3330 :
3340 DEF PROClink(opt)
3350 IF firstopt = Null THEN
3360   firstopt = opt
3370 ELSE
3380   lastopt!Optlink = opt
3390 ENDIF
3400 lastopt = opt
3410 ENDPROC
3420 :
3430 DEF PROCjust_keep(addr,keep)
3440 opt = addr!Option
3450 REPEAT
3460   IF opt <> keep THEN
3470     ans = opt!Answer
3480     REPEAT
3490       obj = ans!Object
3500       IF obj?Objflag = True THEN
3510         obj?Objflag = False
3520         objects -= 1
3530      ENDIF
3540       ans = ans!Answer
3550     UNTIL ans = Null
3560   ENDIF
3570   opt = opt!Option
3580 UNTIL opt = Null
3590 ENDPROC
3600 :
3610 DEF FNexists(addr,text$)
3620 found = False
3630 REPEAT
3640   IF $(addr+Objtext)=text$ THEN
3650     found = True
3660   ELSE
```

Continued ▶

ANIMALS

◀ Continued

```
3670     addr = addr!Objnext
3680   ENDIF
3690 UNTIL found OR addr = Null
3700 = addr
3710 :
3720 DEF FNbest_bet(addr)
3730 best = Null
3740 most = -1
3750 REPEAT
3760   IF addr?Objflag = True THEN
3770     this = addr!Objcount
3780     IF this > most THEN
3790       most = this
3800       best = addr
3810     ENDIF
3820   ENDIF
3830   addr = addr!Objnext
3840 UNTIL addr = Null
3850 = best
3860 :
3870 DEF FNget_object
3880 REPEAT
3890   object$ = FNinput("What were you
thinking of?",1)
3900   obj = FNexists(firsto,object$)
3910   IF obj?Objflag = False THEN
3920     COLOUR 7
3930     PRINT '"I think you're lying!"
3940     valid = FALSE
3950   ELSE
3960     valid = TRUE
3970   ENDIF
3980 UNTIL valid
3990 IF obj = Null THEN
4000   obj = FNadd_object(object$)
4010   newone = TRUE
4020 ELSE
4030   COLOUR 7
4040   PRINT '"I know about ";object$;"
 but can't distinguish it."
4050   newone = FALSE
4060 ENDIF
4070 = obj
4080 :
4090 DEF FNanalyse
4100 IF count = 1 THEN
4110   yes = FNisita(objptr)
4120   IF yes THEN = objptr
4130 ENDIF
4140 IF objects = 0 THEN
4150   COLOUR 7
4160   PRINT'"I give up!"
4170   = FNget_object
4180 ENDIF
4190 IF quests = 0 THEN
4200   pos_obj = FNbest_bet(firsto)
4210   IF pos_obj <> Null THEN
4220     yes = FNisita(pos_obj)
4230     IF yes THEN = pos_obj
4240   ENDIF
4250   COLOUR 7
4260   PRINT'"Oh well, I give up - I've
 run out of questions!"
4270   obj_ptr = FNget_object
4280   qtext$ = "Please enter a new que
stion"
4290   IF newone THEN
4300     qtext$ += " (or Return to igno
re):"
4310     min = 0
4320   ELSE
4330     qtext$ += ":"
4340     min = 1
4350   ENDIF
4360   quest$  = FNinput(qtext$,min)
4370   IF quest$ <> "" THEN
4380     option$ = FNinput("Please ente
r an appropriate answer for "+$(obj+Objt
ext)+":",1)
4390     qst_ptr = FNadd_question(quest
$)
4400     opt_ptr = FNadd_option(option$
,qst_ptr)
4410     PROClink(opt_ptr)
4420   ENDIF
4430   = obj_ptr
4440 ENDIF
4450 = Null
4460 :
4470 DEF PROCupdate(ochain,newobj)
4480 WHILE ochain <> Null
4490   ans = ochain!Answer
4500   found = False
4510   IF ans <> Null THEN
4520     REPEAT
4530       IF ans!Object = newobj THEN
4540         found = True
4550       ELSE
4560         ans = ans!Answer
4570       ENDIF
4580     UNTIL found OR ans = Null
4590   ENDIF
4600   IF found = False THEN
4610     IFFNadd_answer(newobj,ochain)
4620   ENDIF
4630   tmp = ochain!Optlink
4640   ochain!Optlink = Null
4650   ochain = tmp
4660 ENDWHILE
4670 ENDPROC
4680 :
4690 DEF PROCguess
4700 quests   = FNreset(firstq,Question
,Qstflag,FALSE)
4710 objects  = FNreset(firsto,Objnext,
Objflag,TRUE)
4720 firstopt = Null
4730 lastopt  = Null
4740 COLOUR 7
4750 PRINT''"   O.K., think of somethin
g..."'"    -------------------------"
4760 REPEAT
4770   question = FNchoose(firstq)
4780   valid$   = FNshow_question(quest
ion)
4790   reply    = FNget_key(valid$)
4800   PROCremove(question)
4810   count = 0
4820   IF reply > 0 THEN
4830     IF reply = 1 THEN
4840       option$ = FNinput("What answ
er would you like to add?",1)
4850       optaddr = FNadd_option(optio
n$,question)
4860     ELSE
4870       optaddr = FNoptaddr(question
,reply - 1)
4880       count = FNcount(optaddr)
4890     ENDIF
4900     PROClink(optaddr)
4910   ELSE
4920     optaddr = Null
4930   ENDIF
4940   PROCjust_keep(question,optaddr)
4950   solution = FNanalyse
4960 UNTIL solution <> Null
4970 PROCupdate(firstopt,solution)
4980 ENDPROC
```

Listing 2

```
10 REM >AI-Tree
20 REM By David Lawrence
30 REM For Archimedes only
40 REM (c) BAU 1990
50 :
60 ON ERROR PROCsave:END
70 MODE 12
80 PROCinit
90 start = FNsetup
100 REPEAT
110 CLS
120 PROCguess(start)
130 UNTIL FALSE
140 END
150 :
160 DEF PROCinit
170 total = HIMEM - END - &8000
180 DIM mem total,ad%(26)
190 SYS "OS_Heap",0,mem,,total
200 AZ$ = "ABCDEFGHIJKLMNOPQRSTUVWXYZ"
210 Null = 0
220 Yes = 1
230 No = 2
240 Node = 0
250 Leaf = 1
260 ENDPROC
270 :
280 DEF FNsetup
290 PROCprint(7,"Do you want to load a
 file ?")
300 IF FNyorn = Yes THEN
310   fname$ = FNget_item("Please ente
r filename")
320   COLOUR 7
330   file% = OPENIN(fname$)
340   PTR#file% = 1
350   q1 = FNload_node
360   CLOSE #file%
370 ELSE
380   CLS
390   one$  = FNget_item("Solution 1")
400   two$  = FNget_item("Solution 2")
410   text$ = FNget_item("Please enter
 first question")
420   qfo$  = FNget_leaf(one$)
430   qft$  = FNget_leaf(two$)
440   q1    = FNadd_node(text$)
450   one   = FNadd_leaf(one$)
460   two   = FNadd_leaf(two$)
470   PROCadd_option(q1,qfo$,one)
480   PROCadd_option(q1,qft$,two)
490 ENDIF
500 = q1
510 :
520 DEF FNload_node
530 LOCAL q,act
540 q = FNadd_node(GET$#file%)
550 item$ = CHR$(BGET#file%)
560 REPEAT
570 CASE item$ OF
580   WHEN "?" : act = FNload_node
590   WHEN " " : act = FNadd_leaf(GET$
#file%)
600 ENDCASE
610 item$ = CHR$(BGET#file%)
620 PROCadd_option(q,GET$#file%,act)
630 item$ = CHR$(BGET#file%)
640 UNTIL item$ = ">" OR EOF#file%
650 PTR#file% = PTR#file% - 1
660 = q
670 :
680 DEF PROCsave
690 ON ERROR MODE 12:END
700 CLS
710 PROCprint(7,"Do you want to save t
his file ?")
720 IF FNyorn = No CLS:ENDPROC
730 fname$ = FNget_item("Please enter
filename")
740 file% = OPENOUT(fname$)
750 PROCsave_tree(start)
760 CLOSE #file%
770 COLOUR 7
780 CLS
790 ENDPROC
800 :
810 DEF PROCsave_tree(ptr)
820 CASE !ptr OF
830   WHEN Node : PROCsave_node(ptr)
840   WHEN Leaf : PROCsave_leaf(ptr)
850 ENDCASE
860 ENDPROC
870 :
880 DEF PROCsave_node(ptr)
890 LOCAL tmp
900 BPUT#file%,"?" + $(ptr + 8)
910 tmp = ptr!4
920 WHILE tmp <> Null
930   PROCsave_tree(!tmp)
940   BPUT#file%,">" + $(tmp + 8)
950   tmp = tmp!4
960 ENDWHILE
970 ENDPROC
980 :
990 DEF PROCsave_leaf(ptr)
1000 BPUT#file%," " + $(ptr + 4)
1010 ENDPROC
1020 :
1030 DEF FNget(valid$)
1040 REPEAT
1050   key$ = GET$
1060   IF key$ >= "a" AND key$ <= "z" k
ey$ = CHR$(ASCkey$ - 32)
1070   key = INSTR(valid$,key$)
1080 UNTIL key
1090 COLOUR 7:PRINTkey$'
1100 = key
1110 :
1120 DEF FNyorn
1130 COLOUR 1:PRINT"  (Y)";
1140 COLOUR 2:PRINT" or ";
1150 COLOUR 1:PRINT"(N)";
1160 COLOUR 2:PRINT" : ";
1170 = FNget("YN")
1180 :
1190 DEF FNalloc(size)
1200 SYS "OS_Heap",2,mem,,size TO ,,add
r
1210 HeapEnd = addr + size
1220 IF addr > 0 THEN = addr
1230 PRINT "Failed to allocate"
1240 END
1250 :
1260 DEF FNadd_node(name$)
1270 qu = FNalloc(LEN(name$) + 12)
1280 !qu = Node
1290 qu!4 = Null
1300 $(qu + 8) = name$
1310 = qu
1320 :
1330 DEF PROCadd_option(qptr,name$,aptr
)
1340 op = FNalloc(LEN(name$) + 12)
1350 !op = aptr
1360 op!4 = Null
1370 $(op + 8) = name$
1380 find = qptr
1390 WHILE find!4 <> Null
1400   find = find!4
1410 ENDWHILE
1420 find!4 = op
1430 ENDPROC
1440 :
1450 DEF FNadd_leaf(name$)
1460 an = FNalloc(LEN(name$) + 8)
1470 !an = Leaf
1480 $(an + 4) = name$
1490 = an
1500 :
1510 DEF PROCprint(col,str$)
1520 COLOUR col
1530 str$ += " "
1540 REPEAT
1550 spc = INSTR(str$," ")
1560 IF POS + spc > 70 PRINT
1570 PRINT LEFT$(str$,spc);
1580 str$ = MID$(str$,spc+1)
1590 UNTIL str$ = ""
1600 PRINT'
1610 ENDPROC
1620 :
1630 DEF FNget_item(prompt$)
1640 PROCprint(7,prompt$)
1650 PRINT" > ";
1660 COLOUR 2
1670 INPUT ""get_text$
1680 PRINT
1690 = get_text$
1700 :
1710 DEF FNget_leaf(prompt$)
1720 = FNget_item("What would the answe
r for "+prompt$+" be?")
1730 :
1740 DEF PROCguess(ptr)
1750 last = Null
1760 REPEAT
1770 CASE !ptr OF
1780   WHEN Node : ptr = FNnode(ptr)
1790   WHEN Leaf : ptr = FNleaf(ptr)
1800 ENDCASE
1810 UNTIL ptr = Null
1820 ENDPROC
1830 :
1840 DEF FNnode(ptr)
1850 PROCprint(7,$(ptr + 8))
1860 num = 0
1870 opt = ptr!4
1880 WHILE opt <> Null
1890 COLOUR 1:PRINT;"   ";CHR$(num + 65
);") ";
1900 COLOUR 2:PRINT$(opt + 8)
1910 num += 1
1920 ad%(num) = opt
1930 opt = opt!4
1940 ENDWHILE
1950 COLOUR 7
1960 PRINT'"  Select answer (?,^,A-";CH
R$(64 + num);") :";
1970 c = FNget("?^" + LEFT$(AZ$,num)) -
 1
1980 CASE c OF
1990   WHEN 0 : PROCnew_option(ptr)
2000   WHEN 1 : PROCnew_node(ptr,"the r
est of the tree")
2010   OTHERWISE : last = ad%(c - 1): =
 !last
2020 ENDCASE
2030 = Null
2040 :
2050 DEF FNleaf(ptr)
2060 guess$ = $(ptr + 4)
2070 PROCprint(3,"Is it "+guess$ + "?")
2080 IF FNyorn = 2 PROCnew_node(ptr,gue
ss$)
2090 = Null
2100 :
2110 DEF PROCnew_option(ptr)
2120 new$ = FNget_item("What were you t
hinking of?")
2130 qfn$ = FNget_leaf(new$)
2140 new = FNadd_leaf(new$)
2150 PROCadd_option(ptr,qfn$,new)
2160 ENDPROC
2170 :
2180 DEF PROCnew_node(ptr,old$)
2190 IF last = Null ENDPROC
2200 new$ = FNget_item("What were you t
hinking of?")
2210 text$ = FNget_item("Please enter a
 question that would distinguish " + new
$ + " from " + old$)
2220 qfn$ = FNget_leaf(new$)
2230 qfo$ = FNget_leaf(old$)
2240 quest = FNadd_node(text$)
2250 !last = quest
2260 new = FNadd_leaf(new$)
2270 PROCadd_option(quest,qfo$,ptr)
2280 PROCadd_option(quest,qfn$,new)
2290 ENDPROC
```

Listing 3

```
a tiger
a rabbit
a dog
a cat
a man
a snake
a worm
Monkey

?Where would you find one?
>In the zoo
 a snake
>In a house
 a dog
 a cat
 a man
>In a hutch
 a rabbit
>In the jungle
 a tiger
 Monkey
?What does it drink?
>Milk
 a cat
>Tea
 a man
>Water
 a dog
 Monkey
>Carrot Juice
 a rabbit
?What noise does it make?
>None
 a worm
>Meow
 a cat
>Woof
```

Continued ▶

ANIMALS

◀ Continued

```
 a dog
>Eek
 Monkey
?How many legs has it got?
>None
 a snake
 a worm
>Four
 a dog
 a cat
 a rabbit
 a man
```

Listing 4

```
?How many legs has it got?
?What noise does it make?
 a worm
>None
 a snake
>Hiss
>None
 a man
>Two
?Where would you find one?
?What does it drink?
 a cat
>Milk
 a dog
>Water
>In a house
 a rabbit
>In a hutch
 a tiger
>In the jungle
>Four
```

DISC UTILITY

Listing 1

```
10 REM Disc Servicer
20 REM By Phil Strafiter
30 REM For BBC B/B+/M
40 REM (C) BBC Acorn User April 1990
50 :
60 MODE7
70 PROCcode
80 PROCscreen
90 PROCinit
100 PROCscan
110 PROCservice
120 END
130 :
140 DEF PROCcode
150 sheila=&FE80:osword=&FFF1
160 osbyte=&FFF4
170 cmd=&70:trylo=&71:tryhi=&72
180 ctrl=&73
190 FORI%=0TO2STEP2:P%=&900
200 [OPT I%
210 .setup
220 STA block:STX block+1:LDX #3
230 .loop
240 LDA sheila,X:EOR #&C1:STA data,X
250 DEX:BNE loop:INX
260 STX block+5:LDA #105:STA block+6
270 CLC:ADC #22:STA cmd
280 RTS
290 .osfdc
300 STA block+7:STX block+9:JSR sub
310 LDA block+9:AND #&1F
320 CMP #7:BCC ok:LDA #0
330 .ok
340 PHA:LDA #129:LDX #&3E
350 LDY #0:JSR osbyte:PLA
360 RTS
370 .sub
380 LDX #block MOD 256
390 LDY #block DIV 256
400 LDA cmd:JMP osword
410 .code
420 STA ctrl:STX trylo:STY tryhi
430 .loop2
440 LDA trylo:STA block+7:JSR sub
450 LDA tryhi:STA block+7:JSR sub
460 DEC ctrl:BNE loop2
470 RTS
480 .check
490 LDX #verify MOD 256
500 LDY #verify DIV 256
510 JMP &FFF7
520 .verify
530 LDA #13:JSR sheila:EOR #&F4
540 STA block+5:BCC verify
550 LDA block+8:LDX #&1F:LDY #&CC
560 JMP &FFF4
570 .block
580 BRK:BRK
590 .data
600 BRK:BRK:BRK:BRK
610 BRK:BRK:BRK:BRK
620 ]NEXT
630 ENDPROC
640 :
650 DEF PROCscreen
660 FOR I%=1 TO 2
670 VDU129,157,130,141
680 PRINTTAB(3)"BBC Acorn User Disc Servicer"
690 NEXT
700 VDU28,0,24,39,3
710 VDU134:PRINT"Clean which surface (0-3) ?";
720 REPEATD$=GET$:UNTILD$>="0"ANDD$<"4":PRINTD$'
730 VDU134:PRINT"How many tracks (4=40,8=80)  ?";
740 REPEATT$=GET$:UNTILT$="4"ORT$="8":PRINTT$;"0"'
750 T%=10*VAL(T$):A%=VAL(D$):X%=T%
760 CALL setup:CLS
770 ENDPROC
780 :
790 DEF PROCinit
800 DIM E%(T%),E$(6)
810 VDU 32:FOR I%=0 TO T%-1
820 PRINTRIGHT$("00"+STR$(I%),2);CHR$135;" ";
830 NEXT
840 RESTORE 1750
850 FOR I%=1 TO 6:READ E$(I%):NEXT
860 FOR I%=0 TO 19:READ V%
870 I%?verify=V% EOR I%:NEXT
880 PRINT''CHR$134;"Press <SPACE> to start .....";
890 REPEATUNTILINKEY-99:*FX21
900 PRINTCHR$13;SPC30
910 cl$=CHR$31+CHR$0+CHR$12+STRING$(40," ")
920 ENDPROC
930 :
940 DEF PROCscan
950 PRINTTAB(0,10);CHR$134;"Scanning disc..... "
960 FOR I%=1 TO 6
970 VDU 31,6,11+I%,128+I%,255,32
980 PRINTE$(I%)
990 NEXT:VDU30
1000 FOR A%=0 TO T%-1:X%=RND(256)-1
1010 V%=USR(osfdc)AND&FF:E%(A%)=V%
1020 IF V%>0 VDU 128+V% ELSE VDU 135
1030 PRINTRIGHT$("00"+STR$(A%),2);CHR$135;
1040 NEXT
1050 VDU28,0,24,39,11,12,28,0,24,39,3
1060 ENDPROC
1070 :
1080 DEF PROCservice
1090 PRINT
1100 FOR I%=9 TO 10:VDU 31,0,I%,132,141,157,134
1110 NEXT
1120 FOR N%=0 TO T%-1
1130 IF E%(N%)<>0 PROCdo(N%)
1140 NEXT
1150 VDU 26,12
1160 PRINT"Disc serviced, now '*.' it."''
1170 CALL check
1180 ENDPROC
1190 :
1200 DEF PROCdo(t%)
1210 FOR I%=9 TO 10:E%=E%(t%)
1220 PRINTTAB(4,I%);SPC35;TAB(4,I%);"Servicing track ";t%;" (";E$(E%);")";
1230 NEXT
1240 IF E%<4 PROCclean
1250 IF E%=4 PROCflat
1260 IF E%=5 PROCfix
1270 IF E%=6 PROCalign
1280 FOR I%=8 TO 9:PRINTTAB(12,I%);SPC27;:NEXT
1290 PRINTTAB(4*(t% MOD 10),t% DIV 10);" "
1300 ENDPROC
1310 DEF PROCclean
1320 PROCmess("Cleaning")
1330.FOR I%=1 TO 2
1340 X%=5:Y%=T%:A%=2:CALL code
1350 X%=&A:Y%=&26:A%=5:CALLcode
1360 NEXT:PRINTcl$
1370 ENDPROC
1380 DEF PROCflat
1390 PROCmess("Smoothing")
1400 FOR I%=1 TO 2
1410 FOR X%=0 TO &E
1420 Y%=X% EOR &E:A%=1:CALLcode
1430 NEXT
1440 X%=&20:Y%=0:A%=2:CALLcode
1450 NEXT:PRINTcl$
1460 ENDPROC
1470 DEF PROCfix
1480 A%=&57:CALL osfdc
1490 PROCmess("Reading")
1500 FOR A%=0 TO 9:X%=&FE:CALL osfdc:NEXT
1510 PROCmess("Repairing")
1520 X%=0:Y%=2:A%=&4C:CALL code
1530 PROCmess("Reformatting")
1540 FOR A%=0 TO 9:X%=&4B:CALL osfdc:NEXT
1550 PRINTcl$:PROCmess("Writing")
1560 FOR A%=9 TO 0 STEP -1:X%=&53:CALL osfdc:NEXT
1570 PRINTcl$
1580 ENDPROC
1590 DEF PROCalign
1600 PROCmess("Re-aligning")
1610 FOR I%=1 TO 2
1620 A%=T%:CALL osfdc
1630 X%=5:Y%=&A:A%=3:CALL code
1640 NEXT
1650 FOR X%=10 TO T% STEP 10
1660 Y%=X%-5:A%=2:CALL code
1670 NEXT
1680 PRINTcl$
1690 ENDPROC
1700 :
1710 DEF PROCmess(a$)
1720 PRINTTAB(3,12);CHR$129;a$;"...";
1730 ENDPROC
1740 :
1750 DATA dusty,greasy,dirty,uneven
1760 DATA scratched,badly aligned
1770 DATA 42,85,75,87,72,64,38,37,73,121,120,98,96,45,72,96,127,125,48,30
```

COBOL

Listing 1

```
10 REM Small COBOL Run Time Interpreter by Jeff Morgan
20 REM (c) April 1990
50 :
60 IF PAGE<>&1900 THEN PAGE=&1900:CHAIN "RUNTIME"
70 MODE 7
80 PROCinit:PROCerrors
90 ON ERROR e%=FNerr(ERR)
100 PROCreset:PROCconfigure
110 PROCload_pcode:PROCbegin
120 PROCinterpret
130 PROCdetails
150 CHAIN"MENU"
160 END
170 :
180 DEFPROCinterpret
190 LOCAL e%
200 REPEAT
210 lex%=0:end_of_line%=FALSE
220 REPEAT
230 lex%=lex%+1:ptr%=ptr%+1
240 num%=pcode%(ptr%)
250 IF num%=-1 THEN end_of_line%=TRUE
260 IF num%=-2 THEN end_of_program%=TRUE
270 line%(lex%)=num%
280 IF show% PRINT;line%(lex%);" ";
290 UNTIL end_of_line% OR end_of_program%
300 lex%=lex%-1
310 IF show% THEN PRINT
320 e%=FNdiserr(FNdo)
330 UNTIL end_of_program% OR e%>0
340 ENDPROC
350 :
360 DEFPROCinit
370 DIM data$(5)
380 DIM name$(5,50),ptr%(5,50)
390 DIM type$(5,50),len%(5,50)
400 DIM point%(5,50)
410 DIM file%(4),ch%(4),eof%(4),fname$(4)
420 DIM err$(20),line%(15),pcode%(250),lit$(20)
430 VDU 23;10;0;0;0;
440 CLOSE#0
450 ENDPROC
460 :
470 DEFPROCreset
480 end_of_program%=0:ptr%=0:done%=0
490 ENDPROC
500 :
510 DEFPROCerrors
520 LOCAL i%,error$
530 i%=0
540 REPEAT
550 i%=i%+1
560 READ error$
570 IF error$<>"*" THEN err$(i%)=error$
580 UNTIL error$="*"
590 ENDPROC
600 :
610 DEFFNvalue(comp%,i%)
620 LOCAL item%,file%
630 item%=FNvar(comp%)
640 file%=FNfile(comp%)
650 IF i%=1 THEN =FNget_num(file%,item%) ELSE =FNlocate_data_item(file%,item%)
660 :
670 DEFFNdo
680 LOCAL first%,e%
690 first%=line%(1):e%=0
700 IF first%=9 THEN PROCmove
710 IF first%>=10 AND first%<=13 THEN e%=FNoperate(first%-9)
720 IF first%=14 PROCdisplay
730 IF first%=15 e%=FNopen
740 IF first%=16 PROCclose
750 IF first%=19 e%=FNread
760 IF first%=20 e%=FNwrite
770 IF first%=47 THEN PROCgoto(2)
780 IF first%=54 THEN PROCcondition
790 =e%
800 :
810 DEFFNoperate(op%)
820 LOCAL e%,result$,val1,val2
830 val1=FNvalue(line%(2),1)
840 val2=FNvalue(line%(3),1)
850 IF val2=0 AND op%=4 THEN e%=13:GOTO880
860 result$=FNresult(val1,val2,op%)
870 e%=FNins_num(result$,FNfile(line%(4)),FNvar(line%(4)))
880 =e%
890 :
900 DEFFNresult(v1,v2,op%)
910 LOCAL r
920 ON op% GOTO 930,940,950,960
930 r=v1+v2:GOTO 970
940 r=v2-v1:GOTO 970
950 r=v1*v2:GOTO 970
960 r=v1/v2
970 =STR$(r)
980 :
990 DEFPROCdisplay
1000 LOCAL file%,item%,i%
1010 IF lex%=1 THEN GOTO 1090
1020 FOR i%=2 TO lex%
1030 IF line%(i%)<100 THEN PRINT lit$(line%(i%));" ";:GOTO 1080
1040 item%=FNvar(line%(i%))
1050 file%=FNfile(line%(i%))
1060 IF LEFT$(type$(file%,item%),1)="|" THEN PROCdisplay_levels(file%,item%):GOTO 1080
1070 IF type$(file%,item%)="9" THEN PRINT;FNget_num(file%,item%);" "; ELSE PRINT;FNlocate_data_item(file%,item%);" ";
1080 NEXT
1090 PRINT
1100 ENDPROC
1110 :
1120 DEFPROCgoto(i%)
1130 ptr%=line%(i%)-1
1140 ENDPROC
1150 :
1160 DEFPROCmove
1170 LOCAL value$
1180 IF line%(2)<10 AND line%(3)<10 THEN data$(line%(3))=data$(line%(2)):ENDPROC
1190 IF line%(2)<10 THEN PROCmove_record_to_field(line%(2),line%(3)):ENDPROC
```

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```
 1200 IF LEFT$(type$(FNfile(line%(2)),FN
var(line%(2))),1)="|" THEN PROCmove_leve
l(line%(2),line%(3)) ELSE PROCinsert(lin
e%(3),line%(2),FNvalue(line%(2),2))
 1210 ENDPROC
 1220 :
 1230 DEFFNopen
 1240 LOCAL i%,file%,type%,e%
 1250 IF line%(2)=17 THEN type%=-1 ELSE
type%=1
 1260 FOR i%=3 TO lex%
 1270 file%=line%(i%)
 1280 IF file%(file%)<>2 THEN file%(file
%)=type%
 1290 IF ch%(file%)<>0 THEN e%=4:GOTO132
0
 1300 IF type%=-1 THEN ch%(file%)=OPENUP
("D."+fname$(file%))
 1310 IF type%=1 THEN ch%(file%)=OPENOUT
("D."+fname$(file%))
 1320 NEXT
 1330 =e%
 1340 :
 1350 DEFPROCclose
 1360 LOCAL i%,file%
 1370 FOR i%=2 TO lex%
 1380 file%=line%(i%)
 1390 file%(file%)=0
 1400 CLOSE#ch%(file%)
 1410 eof%(file%)=FALSE
 1420 NEXT
 1430 ENDPROC
 1440 :
 1450 DEFFNread
 1460 LOCAL i%,file%,input$
 1470 file%=line%(2)
 1480 IF file%(file%)<>2:IF file%(file%)
<>-1 THEN e%=5:GOTO1550
 1490 IF file%(file%)=2 THEN input$=FNge
t_from_keyboard:GOTO 1540
 1500 IF line%(3)=47 AND eof%(file%) THE
N PROCgoto(4):GOTO 1550
 1510 IF EOF#ch%(file%) THEN e%=2:GOTO 1
550
 1520 INPUT#ch%(file%),input$
 1530 IF EOF#ch%(file%) THEN eof%(file%)
=TRUE
 1540 data$(file%)=input$
 1550 =e%
 1560 :
 1570 DEFFNwrite
 1580 LOCAL i%,file%,e%
 1590 FOR i%=2 TO lex%
 1600 file%=line%(i%)
 1610 IF file%(file%)<>1 THEN e%=6:GOTO1
640
 1620 IF ch%(file%)=0 THEN e%=3:GOTO1640
 1630 PRINT#ch%(file%),data$(file%)
 1640 NEXT
 1650 =e%
 1660 :
 1670 DEFPROCcondition
 1680 LOCAL true%,cond%,val1,val2
 1690 cond%=line%(3)-54
 1700 val1=FNvalue(line%(2),1)
 1710 val2=FNvalue(line%(4),1)
 1720 true%=FNtest(val1,val2,cond%)
 1730 IF true% THEN PROCgoto(6)
 1740 ENDPROC
 1750 :
 1760 DEFFNtest(v1,v2,cond%)
 1770 LOCAL true%
 1780 ON cond% GOTO 1790,1800,1810
 1790 true%=(v1=v2):GOTO 1820
 1800 true%=(v1>v2):GOTO 1820
 1810 true%=(v1<v2)
 1820 =true%
 1830 :
 1840 DEFFNget_from_keyboard
 1850 LOCAL i%,string$
 1860 INPUT;">>"string$
 1870 =string$
 1880 :
 1890 DEFPROCmove_level(v1%,v2%)
 1900 LOCAL file1%,file2%,field1%,field2
%,e%
 1910 file1%=FNfile(v1%):file2%=FNfile(v
2%)
 1920 field1%=FNvar(v1%):field2%=FNvar(v
2%)
 1930 IF LEFT$(type$(file2%,field2%),1)=
"|" THEN PROCmove_to_level(file1%,field1
%,file2%,field2%):ENDPROC
 1940 from$=FNconstruct_data(file1%,fiel
d1%)
 1950 e%=FNinsert_data_item(file2%,field
2%,from$)
 1960 ENDPROC
 1970 :
 1980 DEFPROCmove_record_to_field(from%,
to%)
 1990 LOCAL e%,from$,i%,tf%,tfld%
 2000 from$=data$(from%)
 2010 e%=FNinsert_data_item(FNfile(to%),
FNvar(to%),from$)
 2020 ENDPROC
 2030 :
 2040 DEFFNconstruct_data(file%,field%)
 2050 LOCAL first%,second%,code$,i%,data
$
 2060 code$=type$(file%,field%)
 2070 first%=FNdecode(code$,1)
 2080 second%=FNdecode(code$,2)
 2090 FOR i%=first% TO second%
 2100 data$=data$+FNpad(FNlocate_data_it
em(file%,i%),len%(file%,i%))
 2110 NEXT
 2120 =data$
 2130 :
 2140 DEFFNfirst(file%,field%)
 2150 LOCAL first%
 2160 first%=FNdecode(type$(file%,field%
),1)
 2170 IF LEFT$(type$(file%,field%+1),1)=
"|" THEN first%=first%+1
 2180 =first%
 2190 :
 2200 DEFFNsecond(file%,field%)
 2210 LOCAL second%
 2220 second%=FNdecode(type$(file%,field
%),2)
 2230 IF type$(file%,field%+1)="|" THEN
second%=second%-1
 2240 =second%
 2250 :
 2260 DEFFNdecode(code$,i%)
 2270 =ASC(MID$(code$,i%+1,1))-64
 2280 :
 2290 DEFPROCmove_to_level(file1%,field1
%,file2%,field2%)
 2300 LOCAL code1$,code2$,j%,i%,start1%,
start2%,end1%,end2%,item$,e%
 2310 start1%=FNfirst(file1%,field1%):st
art2%=FNfirst(file2%,field2%)
 2320 end1%=FNsecond(file1%,field1%):end
2%=FNsecond(file2%,field2%)
 2330 j%=start2%
 2340 FOR i%=start1% TO end1%
 2350 item$=FNlocate_data_item(file1%,i%
)
 2360 e%=FNinsert_data_item(file2%,j%,it
em$)
 2370 j%=j%+1
 2380 REM IF j%=end2% THEN i%=end1%
 2390 NEXT
 2400 ENDPROC
 2410 :
 2420 DEFPROCdisplay_levels(file%,field%
)
 2430 LOCAL code$,i%,start%,end%
 2440 start%=FNfirst(file%,field%)
 2450 end%=FNsecond(file%,field%)
 2460 FOR i%=start% TO end%
 2470 item$=FNlocate_data_item(file%,i%)
 2480 IF type$(file%,i%)="9" THEN PRINT;
FNget_num(file%,i%);" "; ELSE PRINT;FNlo
cate_data_item(file%,i%);" ";
 2490 NEXT
 2500 ENDPROC
 2510 :
 2520 DEFPROCcopydata(data$,file%,field%
)
 2530 LOCAL
 2540 IF type$(file%,field%)="|" THEN le
n%=FNintolen(file%,field%) ELSE len%=len
%(file%,field%)
 2550 data$=FNpad(data$,len%)
 2560 first%=FNfirst(file%,field%)
 2570 data$(file%)=FNchop(data$(file%),d
ata$,file%,field%)
 2580 ENDPROC
 2590 :
 2600 DEFPROCconfigure
 2610 LOCAL ch%
 2620 PROChead("Small COBOL RunTime Inte
rpreter")
 2630 VDU 28,1,23,39,2
 2640 REPEAT
 2650 CLS
 2660 input$=FNget_fname(1,7)
 2670 ch%=OPENUP(input$):CLOSE#ch%
 2680 IF ch%=0 THEN PRINT'"NO SUCH FILE!
":PROCspace
 2690 UNTIL ch%=17
 2700 show%=FNans("Show pcode")
 2710 P%=FNans("Print run")
 2720 IF P% THEN IF FNans("Remarks") THE
N rem$=FNget_fname(2,70)
 2730 ENDPROC
 2740 :
 2750 DEFFNget_fname(q%,max%)
 2760 LOCAL x%,y%,f$,file$,d$,ok%
 2770 IF q%=2 THEN q$="Remarks ? ":GOTO
2800
 2780 IF q%=1 THEN f$="Pcode":d$="P"
 2790 q$=f$+" filename ? "+d$+"."
 2800 PRINT'q$;
 2810 x%=POS:y%=VPOS
 2820 REPEAT
 2830 INPUT TAB(x%,y%)file$
 2840 len%=LEN(file$)
 2850 ok%=(len%>0 AND len%<max%+1)
 2860 IF NOT ok% THEN PRINT TAB(x%,y%);S
TRING$(len%," "):VDU 7
 2870 UNTIL ok%
 2880 IF q%=2 THEN =file$
 2890 =d$+"."+file$
 2900 :
 2910 DEFPROCdetails
 2920 PRINT'STRING$(39,"_"):IF P% THEN P
RINT
 2930 PRINT "Run completed."
 2940 PRINT'STRING$(39,"_")
 2950 PRINT'"Press SPACE for menu.";:REP
EAT:UNTIL GET=32:VDU3
 2960 ENDPROC
 2970 :
 2980 DEFFNdiserr(e%)
 2990 IF e%=0 THEN GOTO 3010
 3000 PRINT'">>> ";err$(e%);" ERROR <<<"
'
 3010 =e%
 3020 :
 3030 DEFPROCload_pcode
 3040 LOCAL i%,file%,in%
 3050 PRINT'"Loading <";input$;">"
 3060 in%=OPENUP(input$)
 3070 INPUT#in%,pcode%
 3080 FOR i%=1 TO pcode%
 3090 INPUT#in%,pcode%(i%)
 3100 NEXT
 3110 FOR file%=0 TO 5
 3120 INPUT#in%,data$(file%)
 3130 i%=0
 3140 REPEAT
 3150 i%=i%+1
 3160 INPUT#in%,ptr%(file%,i%),type$(fil
e%,i%),len%(file%,i%),point%(file%,i%)
 3170 UNTIL ptr%(file%,i%)=-1
 3180 NEXT
 3190 FOR i%=0 TO 4
 3200 INPUT#in%,fname$(i%),file%(i%)
 3210 NEXT
 3220 INPUT#in%,lit%
 3230 FOR i%=1 TO lit%
 3240 INPUT#in%,lit$(i%)
 3250 NEXT
 3260 CLOSE#in%
 3270 PRINT'"Loaded."
 3280 PROCspace
 3290 ENDPROC
 3300 :
 3310 DEFPROCbegin
 3320 CLS:IF P% THEN PROCprint_header(in
put$,rem$)
 3330 PRINT'"running..."':ENDPROC
 3340 :
 3350 DEFFNerr(e%)
 3360 IF e%=17 THEN CHAIN"MENU"
 3370 IF e%=194 e%=FNdiserr(4)
 3380 IF e%=222 e%=FNdiserr(7)
 3390 IF e%=191 e%=FNdiserr(8)
 3400 IF e%=198 e%=FNdiserr(9)
 3410 IF e%=195 e%=FNdiserr(10)
 3420 IF e%=190 e%=FNdiserr(11)
 3430 IF e%=201 e%=FNdiserr(12)
 3440 IF e%>3 AND e%<14 THEN PROCdetails
:CHAIN"MENU"
 3450 PROCend
 3460 =0
 3470 :
 3480 DEFPROCend:*FX12,4
 3490 CLOSE#0:VDU3:PRINT''"Sorry, can't
continue. An error has"'"occured in the
Run Time Interpreter"'"itself.":REPORT:P
RINT" at line ";ERL
 3500 END
 3510 :
 3520 DEFFNfile(comp%):=(comp% DIV 100)-
1
 3530 :
 3540 DEFFNvar(comp%):=comp%-(100*(FNfil
e(comp%)+1))
 3550 :
 3560 DEFFNans(q$)
 3570 LOCAL a$
 3580 PRINT'q$;" (Y/N) ? ";
 3590 REPEAT
 3600 a$=GET$
 3610 UNTIL a$="Y" OR a$="N"
 3620 PRINT;a$
 3630 =(a$="Y")
 3640 :
 3650 DEFPROCspace
 3660 PRINT TAB(3,20);"Press SPACE BAR t
o continue";
 3670 REPEAT UNTIL GET=32
 3680 ENDPROC
 3690 :
 3700 DEFPROChead(a$)
 3710 CLS
 3720 PRINTTAB(0,0);CHR$(132);CHR$(157);
CHR$(131);CHR$(141);TAB((39-LEN(a$)) DIV
 2,0);a$
 3730 PRINTTAB(0,1);CHR$(132);CHR$(157);
CHR$(131);CHR$(141);TAB((39-LEN(a$)) DIV
 2,1);a$
 3740 ENDPROC
 3750 :
 3760 DEFPROCprint_header(input$,rem$)
 3770 LOCAL ch$,a$:VDU2
 3780 ch$="=":rem$=LEFT$(rem$,75)
 3790 PRINT STRING$(79,ch$)
 3800 a$="Small COBOL Run Time Interpret
er"
 3810 PRINT ch$;TAB((79-LEN(a$)) DIV 2);
a$;TAB(78);ch$'ch$;TAB(78);ch$
 3820 a$=" Run of file <"+input$+">"
 3830 PRINT ch$;TAB((79-LEN(a$)) DIV 2);
a$;TAB(78);ch$'ch$;TAB(78);ch$'ch$;TAB((
79-LEN(rem$)) DIV 2);rem$;TAB(78);ch$'ST
RING$(79,ch$)
 3840 ENDPROC
 3850 :
 3860 DEFPROCinsert(comp%,from%,val$)
 3870 LOCAL file%,item%
 3880 item%=FNvar(comp%)
 3890 file%=FNfile(comp%)
 3900 e%=FNinsert_data_item(file%,item%,
val$)
 3910 IF point%(FNfile(from%),FNvar(from
%))>0 THEN point%(file%,item%)=point%(FN
file(from%),FNvar(from%))
 3920 ENDPROC
 3930 :
 3940 DEFFNinsert_data_item(file%,item%,
item$)
 3950 LOCAL e%
 3960 IF LEN(item$)<>len%(file%,item%) T
HEN item$=FNpad(item$,len%(file%,item%))
 3970 data$(file%)=FNchop(data$(file%),i
tem$,item%,file%)
 3980 =e%
 3990 :
 4000 DEFFNvalidate(file%,item%,item$)
 4010 LOCAL type$,i%,e%,len%,ok%
 4020 type$=type$(file%,item%)
 4030 IF LEN(item$)>len%(file%,item%) TH
EN e%=1
 4040 IF type$="X" THEN =e%
 4050 len%=LEN(item$):i%=0
 4060 REPEAT
 4070 i%=i%+1
 4080 ch%=ASC(MID$(item$,i%,1))
 4090 ok%=FNvd(type$,ch%)
 4100 UNTIL NOT ok% OR i%=len%
 4110 IF NOT ok% THEN e%=1
 4120 =e%
 4130 :
 4140 DEFFNvd(type$,ch%)
 4150 LOCAL ok%
 4160 ok%=FALSE
 4170 IF type$="9":IF (ch%>47 AND ch%<58
) OR ch%=46 THEN ok%=TRUE
 4180 IF type$="A":IF (ch%>64 AND ch%<91
) THEN ok%=TRUE
 4190 =ok%
 4200 :
 4210 DEFFNvalidate_whole(data$,file%)
 4220 LOCAL item$,i%,e%
 4230 i%=0:e%=0
 4240 REPEAT
 4250 i%=i%+1
 4260 item$=FNlocate_data_item(file%,i%)
 4270 e%=FNvalidate(file%,i%,data$)
 4280 UNTIL ptr%(file%,i%)=-1 OR e%>0
 4290 =e%
 4300 :
 4310 DEFFNchop(a$,item$,ptr%,file%)
 4320 LOCAL left$,right$
 4330 left$=LEFT$(a$,ptr%(file%,ptr%)-1)
 4340 IF ptr%(file%,ptr%+1)=-1 THEN righ
t$="" ELSE right$=RIGHT$(a$,LEN(a$)-ptr%
(file%,ptr%+1)+1)
 4350 =left$+item$+right$
 4360 :
 4370 DEFPROCdis(file%)
 4380 LOCAL i%,item$
 4390 PRINT "FILE : ";file%
 4400 i%=0
 4410 REPEAT
 4420 i%=i%+1
 4430 item$=FNlocate_data_item(file%,i%)
 4440 IF item$<>"|" THEN item$=FNpad(ite
m$,len%(file%,i%))
 4450 PRINT;i%;" ";name$(file%,i%);" '";
item$;"' ";len%(file%,i%);" ";type$(file
%,i%)
 4460 IF point%(file%,i%)>0 THEN PRINT"p
oint at ";point%(file%,i%)
 4470 IF INSTR("S+-",LEFT$(item$,1))>0 T
HEN PRINT "with sign bit"
 4480 UNTIL item$="|"
 4490 PRINT
 4500 ENDPROC
 4510 :
 4520 DEFFNfind_data_item(item$)
 4530 LOCAL i%,match%
 4540 in_file%=0:match%=FALSE
 4550 REPEAT
 4560 i%=0:in_file%=in_file%+1
 4570 REPEAT
 4580 i%=i%+1
 4590 IF item$=name$(in_file%,i%) THEN m
atch%=TRUE
 4600 UNTIL ptr%(in_file%,i%)=-1 OR matc
h%
 4610 UNTIL in_file%=5 OR match%
 4620 IF in_file%=5 AND NOT match% THEN
="|" ELSE =FNlocate_data_item(in_file%,i
%)
 4630 :
 4640 DEFFNlocate_data_item(file%,item%)
 4650 IF ptr%(file%,item%)<>-1 THEN =FNs
horten_R(MID$(data$(file%),ptr%(file%,it
em%),len%(file%,item%))) ELSE ="|"
 4660 :
 4670 DEFFNget_num(file%,field%)
 4680 LOCAL num$,num
 4690 num$=FNlocate_data_item(file%,fiel
d%):sign$=LEFT$(num$,1)
 4700 IF INSTR("S+-",sign$)>0 THEN num$=
sign$+FNshorten_L(RIGHT$(num$,LEN(num$)-
1)) ELSE num$=FNshorten_L(num$)
 4710 =VAL(num$)
 4720 :
 4730 DEFFNins_num(num$,file%,fld%)
```

Continued ▶

COBOL

Listing 1

```
 4740 LOCAL point%,int$,dec$,sp%,is%,ds%,e%,int%,dec%,area$,sg$,sg%
 4750 area$=FNlocate_data_item(file%,fld%):sg$=LEFT$(num$,1):IF sg$="-" OR sg$="+" THEN num$=RIGHT$(num$,LEN(num$)-1)
 4760 IF INSTR("+-",sg$)=0 THEN sg$="+"
 4770 sp%=len%(file%,fld%):point%=INSTR(num$,".")
 4780 IF point%(file%,fld%)<>0 is%=point%(file%,fld%)-1 ELSE is%=sp%
 4790 IF INSTR("S+-",LEFT$(area$,1))>0 THEN is%=is%-1:sg%=TRUE
 4800 int$=LEFT$(num$,point%-1):IF VAL(int$)=0 THEN int$="0"
 4810 IF LEN(int$)>is% THEN e%=1:GOTO 4880
 4820 IF point%(file%,fld%)=0 ds%=sp%:GOTO4860
 4830 ds%=sp%-point%(file%,fld%):dec$=MID$(num$,point%+1):IF point%=0 THEN dec$="0":GOTO 4850
 4840 IF LEN(dec$)>ds% THEN dec$=FNround_up(dec$,ds%)
 4850 dec$=FNpad(dec$,ds%)
 4860 int$=FNppad(int$,is%):IF sg% THEN int$=sg$+int$
 4870 num$=int$+"."+dec$:e%=FNinsert_data_item(file%,fld%,num$)
 4880 =e%
 4890 :
 4900 DEFFNpad(a$,len%):=LEFT$(a$+STRING$(len%,","),len%)
 4910 :
 4920 DEFFNppad(a$,len%):=RIGHT$(STRING$(len%,",")+a$,len%)
 4930 :
 4940 DEFFNshorten_R(a$):IF RIGHT$(a$,1)="," THEN =FNshorten_R(LEFT$(a$,LEN(a$)-1)) ELSE =a$
 4950 :
 4960 DEFFNshorten_L(a$):IF LEFT$(a$,1)="," THEN =FNshorten_L(RIGHT$(a$,LEN(a$)-1)) ELSE =a$
 4970 :
 4980 DEFFNround_up(num$,ds%)
 4990 LOCAL dec$,over$:dec$=LEFT$(num$,ds%):over$=MID$(num$,ds%+1):IF VAL(over$)>=5 THEN dec$=STR$(VAL(dec$)+1)
 5000 =dec$
 5010 :
 5020 REM RTI error messages
 5030 DATA NUMBER TOO BIG,END OF FILE,FILE CLOSED,FILE ALREADY OPEN,FILE WRITE ONLY,FILE READ ONLY,NO SUCH FILE,FILE CAN'T EXTEND,DISK IS FULL,FILE IS LOCKED,CATALOGUE FULL,DISK IS READ ONLY,DIVISION BY ZERO
 5040 DATA *
```

Listing 2

```
 IDENTIFICATION DIVISION.
 PROGRAM_ID INPUT_NAMES.
 AUTHOR JEFFREY MORGAN.
 DATE_WRITTEN AUGUST_89.
 REMARKS THIS PROGRAM GETS NAMES & CRE
ATES A FILE CALLED "D.DATA".
 ENVIRONMENT DIVISION.
 CONFIGURATION SECTION.
 SOURCE_COMPUTER BBC_MICRO.
 OBJECT_COMPUTER BBC_MICRO.
 INPUT_OUTPUT SECTION.
 FILE_CONTROL.
 SELECT INFO ASSIGN DISK.
 SELECT BUFFER1 ASSIGN KEYBOARD.
 SELECT BUFFER2 ASSIGN KEYBOARD.
 DATA DIVISION.
 FILE SECTION.
 FD INFO.
 LABEL RECORDS ARE OMITTED.
 01 INFO.
    02 NAME.
       03 FORNAME PIC X(10).
       03 SURNAME PIC X(10).
    02 AGE PIC 99.
 FD BUFFER1.
 LABEL RECORDS ARE OMITTED.
 01 STRINGS PIC X(10).
 FD BUFFER2.
 LABEL RECORDS ARE OMITTED.
 01 NUMBERS PIC 99.
 WORKING_STORAGE SECTION.
 01 INC PIC 9 VALUE IS 1.
 01 COUNT PIC 9.
 01 LAST PIC 99.
 01 MAX PIC 99 VALUE IS 10.
 PROCEDURE DIVISION.
 DISPLAY "CREATE NAMES FILE".
 DISPLAY.
 OPEN INPUT BUFFER1 BUFFER2.
 OPEN OUTPUT INFO.
 LOOP.
 DISPLAY "How many names ( <" MAX ") ?
"
 READ BUFFER2.
 MOVE NUMBERS TO LAST.
 IF LAST GREATER THAN MAX GO TO LOOP.
 LOOP1.
 IF COUNT EQUAL TO LAST GO TO ENDING.
 DISPLAY.
 DISPLAY "Enter record : " COUNT.
 DISPLAY.
 DISPLAY "Forname :".
 READ BUFFER1.
 MOVE STRINGS TO FORNAME.
 DISPLAY "Surname :".
 READ BUFFER1.
 MOVE STRINGS TO SURNAME.
 DISPLAY "Age :".
 READ BUFFER2.
 MOVE NUMBERS TO AGE.
 DISPLAY.
 ADD INC TO COUNT GIVING COUNT.
 WRITE INFO.
 GO TO LOOP1.
 ENDING.
 CLOSE INFO BUFFER1 BUFFER2.
 DISPLAY.
 DISPLAY "INFO file created.".
 RUN STOP.
```

Listing 3

```
 IDENTIFICATION DIVISION.
 PROGRAM_ID DISPLAY_NAMES.
 AUTHOR JEFFREY MORGAN.
 DATE_WRITTEN AUGUST_89.
 REMARKS THIS PROGRAM DISPLAYS NAMES I
N THE FILE "D.INFO".
 ENVIRONMENT DIVISION.
 CONFIGURATION SECTION.
 SOURCE_COMPUTER BBC_MICRO.
 OBJECT_COMPUTER BBC_MICRO.
 INPUT_OUTPUT SECTION.
 FILE_CONTROL.
 SELECT INFO ASSIGN DISK.
 DATA DIVISION.
 FILE SECTION.
 FD INFO.
 LABEL RECORDS ARE OMITTED.
 01 INFO.
    02 NAME.
       03 FORNAME PIC X(10).
       03 SURNAME PIC X(10).
    02 AGE PIC 99.
 WORKING_STORAGE SECTION.
 01 INC PIC 9 VALUE IS 1.
 01 COUNT PIC 9.
 PROCEDURE DIVISION.
 DISPLAY "DISPLAY NAMES FILE".
 DISPLAY.
 OPEN INPUT INFO.
 LOOP.
 READ INFO AT END GO TO ENDING.
 DISPLAY.
 DISPLAY "Record : " COUNT.
 DISPLAY.
 DISPLAY "Name : " FORNAME SURNAME.
 DISPLAY "Age  : " AGE "years".
 DISPLAY.
 ADD INC TO COUNT GIVING COUNT.
 GO TO LOOP.
 ENDING.
 CLOSE INFO.
 DISPLAY.
 DISPLAY "End of INFO File.".
 RUN STOP.
```



The Beebs of *BAU* are pining and the Arcs aching for your programs. If you have written an application in BBC Basic or assembler suitable for publication in *BBC Acorn User*, we want to know about it.

Of course you may just have hit upon the best programming technique since sliced yoghurt. We want to know about that too. If you can tell the rest of us a thing or two, what better way to do so but in the pages of the biggest, brightest and best Acorn mag in all Christendom?

All programs used are paid for and you get your name in lights (or in print, at least) next to your masterpiece in the auspicious pages of this much sought after magazine.

So, don't delay. Send in your programs (on disc please, along with a stamped addressed envelope if you want the disc returned) and a brief description of what, why and how the program does whatever it does, to:

The Editor
BBC Acorn User
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London N1 6DJ

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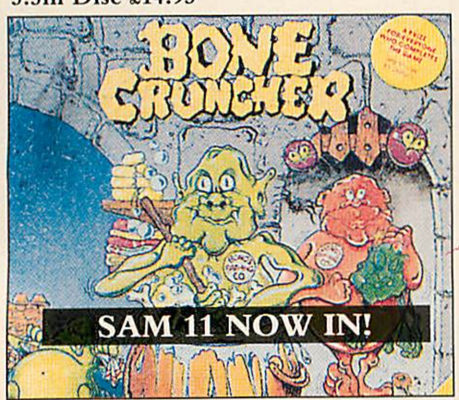
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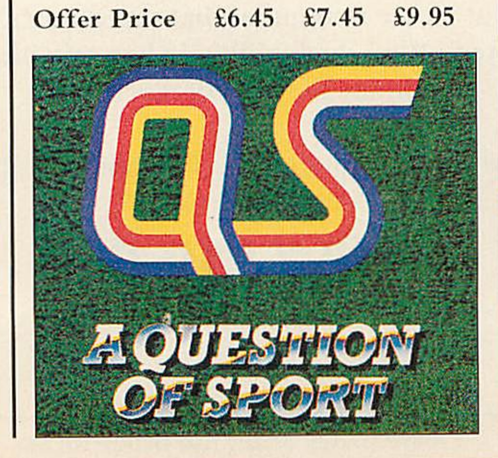
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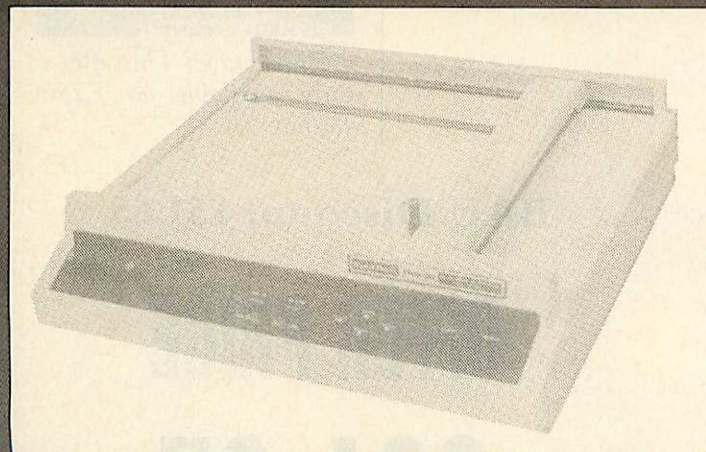
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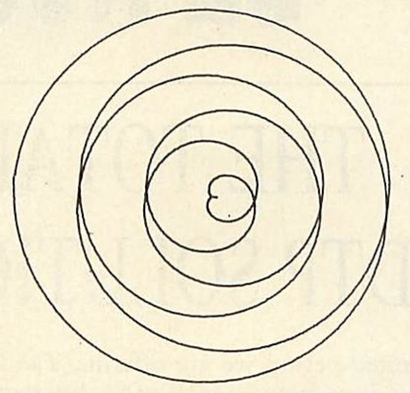
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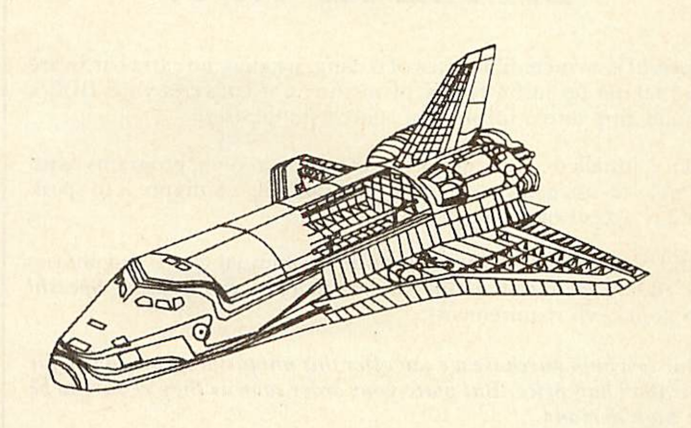


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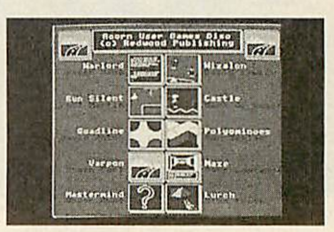
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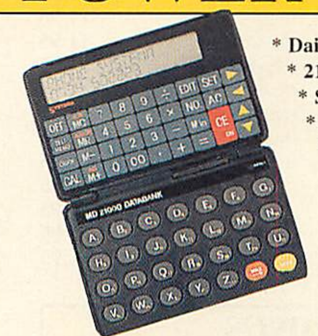
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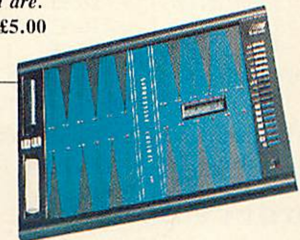
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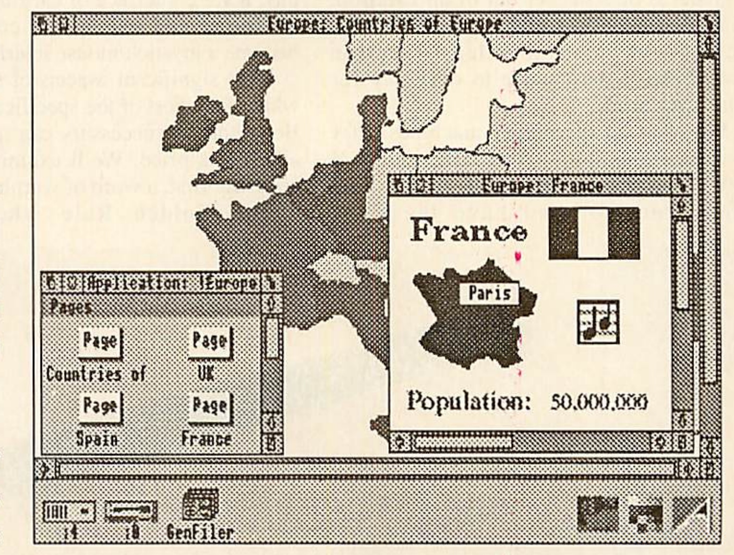
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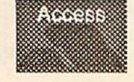
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SUM OF THE PARTS

There's still plenty of life in the old Electron yet and **BERNARD EMBLEM** has been looking at the whole range of add-on goodies for his favourite machine

Despite its demise some time ago, the Electron was (and still is) an excellent product. Those who have used this little machine for some time know that it has proved more reliable and has lasted longer than many better hyped machines which are no longer around.

Evidence of a significant and loyal user base lies in the fact that new hardware is still appearing. Although one of the best known companies, Slogger, has given up the ghost, its main rival, Pres, has stayed the course and now provides a comprehensive range of products we once fondly imagined would come from Acorn.

First, let's make it clear you can't make a model B or a Master out of an Electron. If that's what you really need, that's what you should buy. But at least Electron owners have the chance to only pay for what they need.

So, what do the bigger machines offer that Electrons don't? The BBC model B and the Electron share the same microprocessor and have the same amounts of both Rom and Ram. However, the Beeb runs at roughly twice the Electron's speed, has four sound channels as opposed to one, an economical teletext mode and an unusually wide range of interfaces and expansion possibilities.

Masters have all this plus two cartridge slots, built-in Disc Filing System (DFS) and Advanced Disc Filing System (ADFS), plus a numeric keyboard. They run faster and have more memory.

Then there's the Compact, of course, and this falls somewhere between the two, with more memory than the Beeb, with ADFS and a 3.5in drive but with no user, analogue, or cassette ports and no 1MHz bus, RS232 interface or cartridge slots and analogue and user ports combined to become a joystick/mouse interface.

Most significant aspects of the Electron which fall short of the specifications of the Beeb and its successors can now be met, albeit at a price. We'll examine all these areas but first, a word of warning.

The Golden Rule when buying computer equipment is proceed with care. Many products do not live up to expectations, so fools who rush in often get their fingers burnt. Think carefully about what you want your machine to do, study the advertisements critically, read *BBC Acorn User* avidly and, if in any doubt, question suppliers.

It's no use complaining that a product doesn't do what you wanted, or is incompatible with another piece of equipment, if you didn't make your needs clear before parting with your cash.



The unadorned Electron. Gone but not forgotten

Speed and memory

Speed is a sometimes pointless obsession among the computing fraternity – some of the most successful micros have been pretty slow movers on paper.

In fact, Electrons run at a perfectly respectable speed. However, many an Electron owner has cast an envious eye at model B benchmark timings.

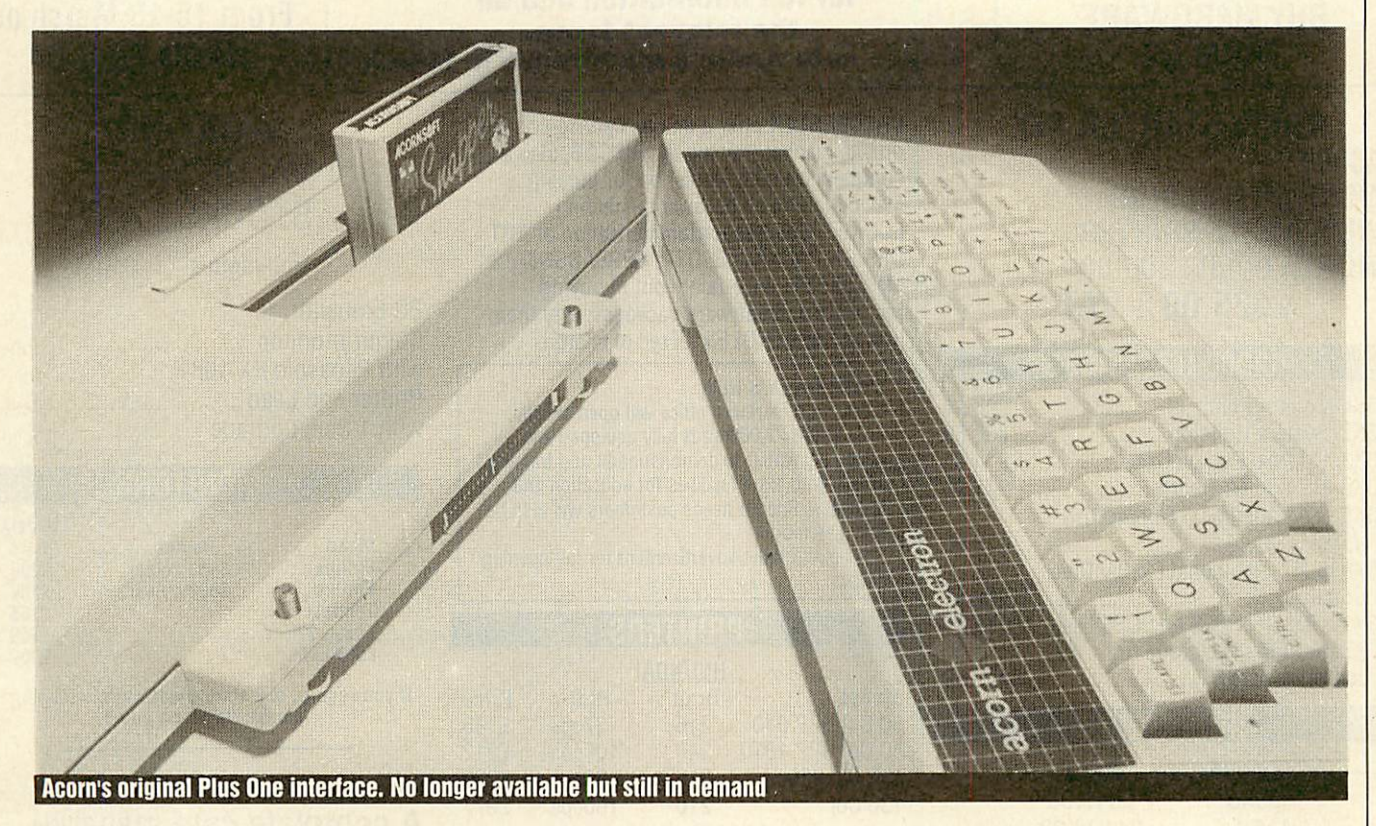
Though Slogger is no longer active, its products are available through third parties and in the secondhand market, so it's worth mentioning the two outstanding Slogger products, the Turbo board and the Master Ram board.

When fitted with a Turbo board, an Electron runs as fast as a model B. This is impressive but with Electron versions of most Beeb games readily available, and usually playing as well as the model B version, the Turbo board has limited value for the games player. It is useful if you write programs for your own use or if you want the normally sluggish cursor on your wordprocessor to go faster, but as no software house has, to my knowledge, ever produced a version of a game or program to take advantage of this ingenious piece of hardware, its value is limited.

The Master Ram board offers the same speed advantages plus extra memory. Using a technique similar to that applied by Acorn on the Master, the board uses shadow Ram to take care of the screen display, freeing the existing Ram to deal with programs. This gives 20K of available Ram in any mode. Again the advantage is to the programmer or serious user, since it is another feature not exploited by any software house.

Mode 7

Mode 7 is not just one of seven modes, it's the most economical, attractive and familiar Acorn mode. Jafa Systems once produced a mode 7 adaptor, still available as a kit, which proved too expensive to sell ready assembled. Now Jafa's come up with a mode 7 simulator which gives access to teletext control codes, a slightly unusual character set (it uses mode 2) and, perhaps most seriously, allows you to use the Electron as a viewdata terminal.



Acorn's original Plus One interface. No longer available but still in demand

What's more, it costs only £25!

Because of the memory requirements of mode 2, though, the simulator works most effectively with the Master Ram board or a second processor.

Any advance

The Electron is unable to communicate directly with anything but a cassette player and a TV or monitor in its unexpanded form. However, Acorn did provide a means of contacting the outside world, known as the Plus One, which featured a Centronics parallel printer port, a joystick interface, and two cartridge slots for Roms.

If you're interested in interfacing your machine with anything, a Plus One is the first thing to consider. The original interface is no longer available but the Advanced Plus1 is. This is to all intents and purposes, an Acorn Plus One, complete with a standard Acorn Plus One User Guide, and Acorn's name on the inside of the case but made by Pres, with Acorn's blessing, for £58.

So, while I've some quibbles about the slightly misleading 'advanced', I've none about the product, which looks, feels, and behaves, just like the Plus One I bought back in 1984.

Roms and printers

Much of Acorn's surplus Electron related stock ended up in Leeds, with Software Bargains which became the main source of original Electron hardware. Perhaps the best buy has been the Acornsoft *View* wordprocessor and *Viewsheet* spreadsheet Rom cartridges which originally sold at around £50 each.

At less than half this price for the pair, they are excellent value, but have required a Plus One or AP1. The company recently ran out of stocks of the Plus One which is replaced by the imaginatively named Rom Cartridge and Printer Interface board.

This new interface is available in three configurations, Basic (one cartridge port) for £30, Extended (one cartridge port/printer interface) for £37 and Full (two cartidge ports/printer interface) for £40. *View* and *Viewsheet* Roms come with each board.

This is undoubtedly the cheapest way to effective wordprocessing on the Electron. The cartridge slots can also be used to run other Rom based software, such as Logo and Lisp, and to plug in the Advanced Plus Three disc interface from Pres. It's worth noting that the AP3 is the only disc system which works reliably with this interface, whatever the adverts might imply.

Unfortunately, the board is an uncased printed circuit board, susceptible to coffee spills, and is a press fit, susceptible to losing data if the computer is moved – even slightly.

Rom cartridges are an excellent alternative to naked Roms. They safely contain Roms and their many delicate little legs are in a protective case any child could use (and mine frequently does). Some Electron Roms such as *View* come in their own cartridges but for those which don't, such as Jafa's mode 7 simulator, Pres supplies an Advanced Rom Adaptor (£15) – an empty cartridge into which you can fit one or two bare Roms.

Raw power

While on the subject of cartridges, everyone who uses them should buy the next item, by far the cheapest, yet undoubtedly one of the most effective items of hardware I've ever used.

The only drawback of cartridges is having to switch the machine off and then on again every time you change one. Unless you trek over to the wall and switch off there, you have to pull out the plug at the micro. This little plug is just not up to the job and soon develops loose connections. Pres's £4.55 power switch fits between micro and plug and completely solves this problem.

Advanced Plus 6

If you use several Roms regularly, you'll be interested in another, more elegant, solution to the problem of too many Roms and too few cartridge slots, the AP6, a £38 upgrade which allows up to six Roms to be fitted inside the Plus One.

However, fitting the AP6 is a nerve-racking experience, particularly if you're upgrading a standard Acorn Plus One. The instructions begin 'Pres can not take any responsibility for damaged items if you proceed with this section' and the ominous 'The following description assumes a level

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136 Col 920	216	37cps	£230
136 Col	210	100cps	£277

JUKI

Model	Draft	NLQ	Price
55 10 (P) 80 Col	180	30cps	£141
7100 24 Wire	288	96cps	£467
7200 CP 24 WAE	324	108cps	£1167

EPSON

Model	Draft	NLQ	Price
LX800	150	25cps	£244
FX850	200	40cps	£369
EX800	250	50cps	£506
132 FX1050	264	54cps	£482
136 EX 1000	250	50cps	£667
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Model	Draft	NLQ	Price
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136 COLUMN			
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of competence'. Pres will fit the AP6 for you and offers a technical helpline every evening and weekend. Non-experts should seriously consider this option. Aligning a total of 78 pins (many of which are partially hidden from view) in four sockets is not easy when you're not used to it.

Nevertheless, once it's in, the AP6 provides an excellent alternative to swapping cartridges.

Discs

Every Electron owner will be well aware of the many drawbacks of using slow and unreliable cassettes to store data. Nevertheless, they are far cheaper than disc interfaces and drives, and programs on cassette are always cheaper too.

What's more, while software houses provide their programs on disc as a matter of course for all other Acorn machines, most Electron programs have only been available on cassette. Until now, that is. Superior Software recently signed an agreement with Pres which licences Pres to produce all the Superior/Acornsoft back catalogue and future releases on disc.

While games load faster and more reliably, again it's the serious user who'll benefit most from upgrading to discs. Programmers will find their problems halved, as will users of databases, wordprocessors and spreadsheets.

There are two filing systems available: the Advanced Disc Filing System (ADFS) and the 1770 Disc Filing System (DFS), and two sizes of disc: 3.5in and 5.25in.

If you want to transfer your wordprocessing files to another machine, use or share software, or write programs for others to use, the overriding factor when choosing a disc interface and drive will be the other machine's filing system and disc size.

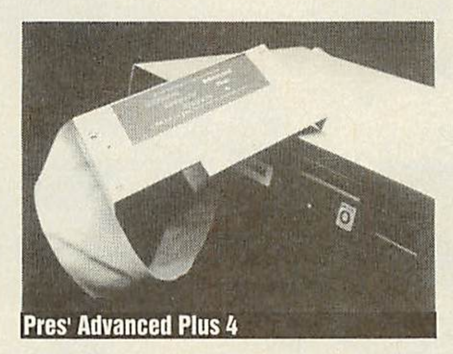
On the whole, although this is by no means a rigid rule, model Bs use DFS and 5.25in discs, Master Compacts use ADFS and 3.5in discs, and Masters come with both DFS and ADFS and tend to use 5.25in discs, especially in schools.

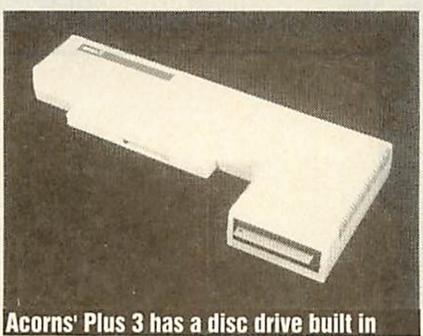
DFS is simpler to use but ADFS offers more facilities. Cheaper to buy, and more widely used are 5.25in discs, but 3.5in discs are far more robust and can store more information.

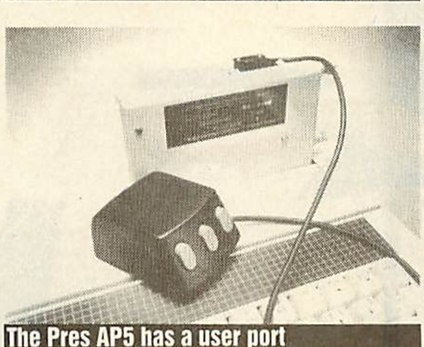
Only two disc interfaces are currently available. Both plug into a cartridge slot and so require an interface such as Acorn's Plus One or Pres' AP1.

Acorn's Plus 3, an all-in-one ADFS and 3.5in drive, originally sold at £199 and was generally regarded as a bit expensive. It also suffered from the fact that both ADFS and 3.5in discs were a little ahead of their time – Beeb owners were still getting used to DFS.

If you want to stay close to Acorn's


Pres' Advanced Plus 4


Acorns' Plus 3 has a disc drive built in


The Pres AP5 has a user port

ADD-ON	SUPPLIER	SPEED	DISC	RAM	ROM	PRINTER	PRICE
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Master Ram Board	Slogger	•		•			2nd hand
Mode 7 Simulator	Jafa Systems						£25
Plus One	Acorn				•	•	2nd hand
Advanced Plus One	Pres				•	•	£58
Rom Cartridge Interface	Software Bargains				•		£30
Rom Cartridge/ Printer Interface	Software Bargains				•	•	£37
2-Rom Cartridge/ Printer interface	Software Bargains				•	•	£40
Rom Cartridge	Pres				•		£15
Power Switch	Pres						£5
Advanced Plus 6	Pres				•		£38
Advanced Plus 3	Pres		•		•		£60
Advanced Plus 4	Pres		•		•		£70
Advanced Plus 34	Pres		•				£80
AP3/3.5in drive	Pres		•		•		£149
AP4/5.25in drive	Pres		•		•		£170
Advanced Plus 5	Pres				•	•	£68

Prices include VAT and are rounded to the nearest whole pound

Comparing the add-ons available

original equipment, you'll be pleased to know that Pres now provides all the facilities of Acorn's Plus 3, and more but without the disc drive, in the £60 Advanced Plus 3 Mk11, which comes with a Welcome disc and three free games on disc. The AP3 is so close to the original that Pres even includes a copy of Acorn's User Guide to the Plus 3.

The AP3 looks like a large Rom cartridge into which plugs the disc drive cable. Although it 'loses' you one cartridge slot, the AP3 can be unscrewed to reveal an internal Rom socket, best used to hold any other piece of Rom based software you use regularly.

Broadly similar in design, but £10 dearer, is the AP4, a 1770 DFS interface which also comes with a comprehensive User Guide, a spare internal 16K Rom socket and DFS utilities. The great attraction of this system is that it provides full compatibility with Beebs and Masters.

The AP34 is dearer still, but offers both ADFS and DFS. Well worth considering if you want to share discs with a wide variety of other users. I've been using this combination with both sizes of discs, transferring data to and from a model B and a Master effortlessly.

The AP34 is cheapest bought as a unit but you can buy the AP3 and then an AP4 Rom to fit in the internal Rom socket, or vice versa.

Before committing yourself to one of these interfaces, study the advertisements to see if any of the packages offered would suit you. Typical systems work out at around £150 for ADFS and 3.5in drive or £170 for DFS and 5.25in drive.

If you do decide to buy separately, you will find that, although 3.5in drives tend to be cheaper, they are also less readily available, and remember that drives for the Electron, unlike those for the Beeb must have their own power supply unit.

Advanced Plus 5

Finally, the AP5 – a specialised and expensive product. It contains a user port, for connecting peripherals such as a mouse or concept keyboard (although, it is not completely software compatible with the BBC user port), a 1MHz bus for devices such as the Music 5000, a Tube socket for connection of hardware such as the Acorn 6502 and Z80 second processors, plus the inevitable spare Rom socket.

With a disc drive interface, a Jafa mode 7 adaptor (if you can find one) and an AP5, your Electron is so close to a model B as makes little difference.

Conclusion

Electron owners wishing to upgrade their machine will find themselves better served now than at any time in the machine's history.

Five years on, the Electron has proved a robust and versatile machine, with a compact but loyal user base and some interesting expansion possibilities.

Upgrading a micro is a potentially rewarding but expensive hobby. There hasn't been space here to describe every Electron add-on ever produced nor to tell you that much about those included. However, with some careful planning and a shrewd eye for the small ads it is easy to take your Electron on almost any upgrade path you could ask for.

Desk top ■ publishing

The professionals' ■ choice

IMPRESSION

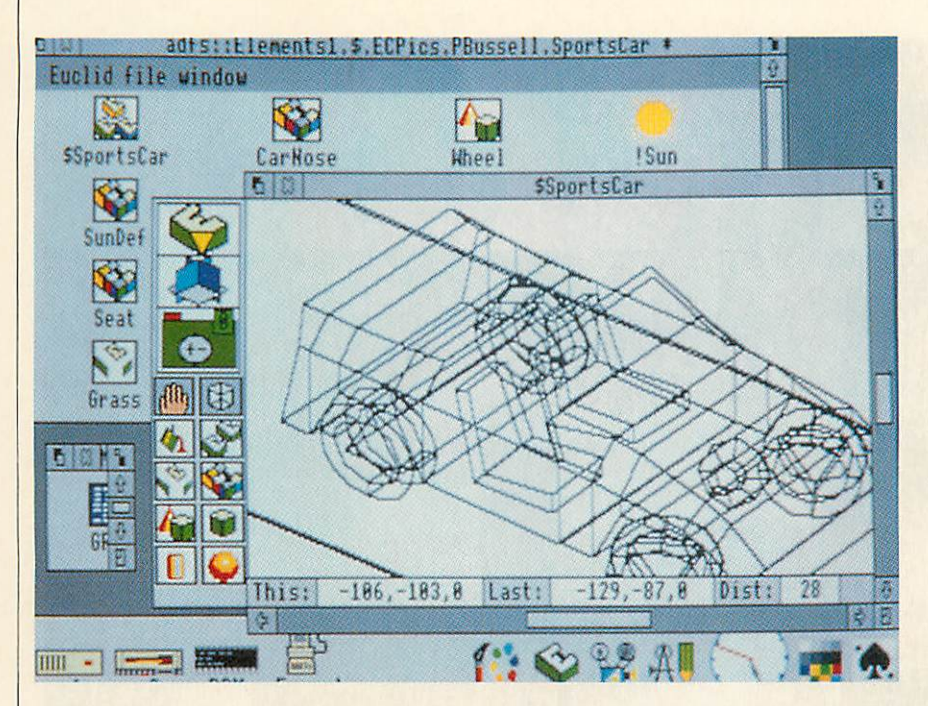
- Full capability DTP
- Full feature word processing
- Multiple documents in memory
- Multiple windows on each document
- Any scale view from 1%–900%
- Automatic hyphenation
- Built-in spelling checker
- Spell check as-you-type
- Full 24-bit RGB, CMYK & HSV colour control
- Fast character mode printing
- 300K free workspace on a 1Mbyte machine
- Supplied with 13 outline fonts
- Flowing graphics with text
- Automatic index generation
- Automatic contents generation
- Automatic abbreviation expansion
- Automatic file conversion from other WPs
- Virtual memory system—unlimited document size
- Simple to use—only 5 main menus



Computer Concepts Ltd

Gaddesden Place
Hemel Hempstead
Herts HP2 6EX
Tel. 0442 63933

If other programs can offer all these features, then they might be as good as Impression.



ON SOLIDS

The famed Euclid modeller is now available in a fully Risc OS version as RICHARD BROWNING discovers

The *Euclid* CAD package was, and is, the only object-oriented graphics modeller for the Arc. This means a scene is compiled from a hierarchy of objects, all descended from the root object.

Almost the same as the structure of an ADFS disc, the *Euclid* approach has a difference – if one object is 'cloned' for use in several other objects, changing the original object will change all the others. In other words, the original object definition is linked to its clones.

Good as the original *Euclid* was, the learning curve was steep. With the changeover to Risc OS, however, most of the difficulties have been surmounted (it now responds properly to !Help) with impressive improvements to boot.

Risc OS and Euclid

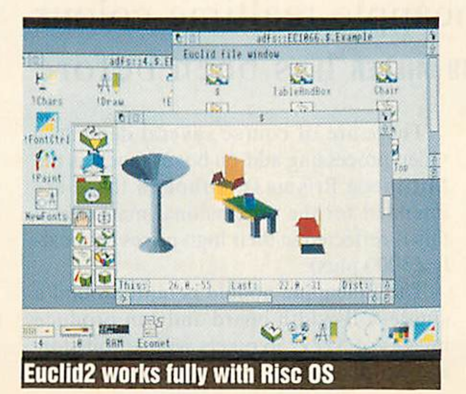
Although *Euclid* can work in any graphics mode the full benefit is only gained when it's used in a 256-colour mode, preferably mode 15.

Starting the program up is now simply a matter of clicking on its icon. You can have as many copies of *Euclid* running as you want, subject to memory. Clicking on the icon which appears in the icon bar, the object structure for the current design appears. When you first begin, the structure will be empty – all you get is a '$' root object to start from.

One feature I would like is a facility to view the actual object hierarchy, with links. As it is you have to remember which object is subject to which.

Each object has its own scene window (with tools). If a change in one window causes a change in any others (containing a linked object), the change is made.

As an example of object hierarchy, take one of the supplied demo files, 'RoomView'. At the root level, an entire room is displayed – complete with chairs, table, pot plant and so on. Going down a level you may encounter the table. Going down still further, each of the four legs of the table then one of the legs, then the six planes of the legs, then the vertices of the planes. You get the idea.



Euclid2 works fully with Risc OS

At each of those stages, there is an object which can itself be manipulated in almost any number of ways.

Tools

There are several objects built as defaults within *Euclid*: sphere, cylinder, cuboid and the like and also more basic elements – meshes, sheets and planes.

A mesh is best thought of (as the manual says) as a rectangular array of rectangles from which virtually any shape can be constructed. *Euclid* can quite happily stretch, rotate or extrude any object in real time.

The second element, the sheet, produces an object specified by the direction of two 'paths' in a horizontal and vertical plane.

Depending on what type of object you're editing (mesh, cuboid, sheet or whatever) a variety of tools is available. These include circles, rectangles and regular polygons. *Euclid2* allows the use of Bezier curves just like *!Draw* and faces can be imported as *!Draw* files. An object can also be coloured with any of the available shades.

You can view any object in plan, isometric or any other 3D view and rotation is, again, in real time – simply done by dragging the 'hand' tool.

Illuminating

There are two types of light source – 'sun' or 'light' – casting diffuse or point source light. Each source is definable, from its colour down to its appearance!

The shading effect is seen by selecting 'Lit' from the 'Style' submenu, from within which other effects can be gained: wireframe, edges outlined and so on.

Up to 10 'cameras' can be positioned in the scene. Each camera has its own definable 'focal length' and 'zoom' along with direction. Switching to the view from the camera, it's easy and fun to 'walk' through your design. Now you can feel how Gulliver felt.

The manual is well written, with clear sections. Although I think a list of error messages would be useful, along with diagrams now and again.

Conclusion

It's hard to believe you can buy such a modelling system for only 70 notes, as hard as it is to believe you can get a computer ready to run it for under £800.

For three dimensional solid modelling and design, I'd find it very hard indeed not to recommend *Euclid*.

Euclid2 cost £70 from Ace Computing, 27 Victoria Road, Cambridge CB4 3BW. Tel:(0223) 322559.



A PIECE OF THE ACTION

Venture forth into the wonderful world of video processing with the Pineapple realtime colour digitiser where only **ROB MILLER** has been before

One use of a computer which really profits from speed is video digitising. Watford Electronics' digitiser for the Archimedes has already shown what Acorn's 32-bit micro is capable of. Now Pineapple has overtaken this and produced one of the 'ultimate' computer-based video digitisers.

There are of course several dedicated video processing add-on boxes (such as the Millipede Prisma3), although these are intended for the professional market and this is reflected in their high prices (typically £3000 plus).

The Pineapple podule is built around a single full-width board and can produce images of 512x256 pixels with 16-bit storage per pixel. This gives a possible 65,536 colours, all of which can be reproduced on a mode 15 screen using dithering.

The board itself consists of the digitiser circuitry, a 256K Ram bank (used as the framestore) and three potentiometers to control colour saturation, brightness and contrast. Two inputs are provided. One is for a standard Pal 1 volt signal and the other is for straight RGB.

On inspection, it would appear that the board is made to a very high standard. The cheap price certainly does not mean that Pineapple has skimped on any of the parts. The sockets for example are very solidly mounted and the whole board has a satisfying air of 'robustness'.

Fitting the podule is simple enough. Just take the lid off your machine and insert the board into a vacant slot in the back-plane. Archimedes 300 series owners will of course require the addition of the backplane to their machine.

Typing *PODULES should show that the digitiser is present and ready to use.

At present, the software is completely disc-based and so a small bit of module space must be configured before use. Pineapple has taken this approach to make

software development and subsequent upgrading simpler. A number of enhancements are planned for the future, including a full Risc OS desktop windowed version of the software.

Most users are likely to use the Pal input for grabbing pictures and this will accept input from a number of sources.

Most modern video recorders will have a video-out socket (usually labelled 'video' or 'CVBS') or perhaps a Scart socket (also variously called a Euroconnector or Peri Television connector).

In the case of the Scart, a suitable cable can be made up simply. A colour video camera should also work perfectly well. Finally, a TV signal could be taken from some televisions or one of the 'Convert-your-monitor-into-a-television' adaptors made by the likes of Philips.

Soft focus

To understand the software and how it works, it is necessary to understand how the digitiser itself actually works. Several demonstration programs are supplied with the digitiser and show what can be achieved using the new star commands provided by the module.

One command sets up the function keys to make control simpler, while the other produces a kind of 'storyboard' of successively grabbed frames on one screen.

As mentioned before, the podule has an area of Ram known as the framestore. This is continually updated (providing a signal is present) at 50 frames each second. The 'real-time' aspect of the digitiser comes from this.

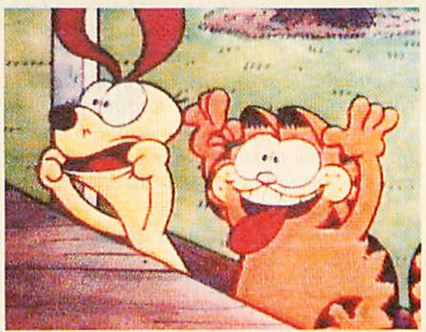
The picture is stored as a series of 16-bit pixels (five bits red, six bits green and five bits blue) giving a possible 65,536 colours. Dithering is used to achieve the full palette and this works particularly well in higher resolution modes.

One command controls the number of bits used for each colour in the pixel. Issuing the command '*BITS 0 0 0' will result in a totally black screen as all colours have effectively been turned off. Setting a low number of bits results in the picture being 'posterised'. That is, areas of similar colour (such as somebody's face) will appear as one 'average' colour.

When a 'grabbed' frame is to be displayed, the memory in the framestore must be converted and transferred into the relevant Arc screen Ram. This takes slightly longer, so there is a noticeable delay when grabbed frames are being shown successively on screen. The command *MOVING is used to monitor the incoming video signal and takes approximately half a second to update the display on a quarter screen size mode 15 display.

The contents of the framestore can be converted into any graphics mode you want, including even mode 0 where pictures are formed from different patterns of black and white pixels. You could then of course digitise screens which can be used on the BBC model B.







The results are excellent and could almost be described as photographic

The framestore can be manipulated in a number of ways to achieve different screen effects. It is possible to obtain monochrome images by simply issuing a *MONO command. This effectively adds the levels of red, green and blue together, which gives a perfectly satisfactory 16 grey-scale image. Mode 12 is best used for this as only 16 colours are needed and 80K of disc space can be saved. While on the subject of disc space, a screen compression routine is not really effective unless you are saving thresholded screens.

A 65,536 colour screen contains mostly dithered pixels so a compression routine is unlikely to work effectively.

The framestore memory can be saved directly to disc (at full 16-bit resolution) and this requires a 256K file. Even with an extended format ADFS disc, you're only going to get three pictures per disc.

Because of the high resolution of the digitiser, it is not possible to see individual pixels on the full screen display. It is possible, however, to select an area of the frame and zoom in.

Any level of magnification is possible from the full screen right down to a single pixel. As you move further in, the picture becomes more and more pixelated although this can be improved to some extent by the use of 'smoothing' software.

Such a smoothing routine is currently under development and will attempt to merge adjacent pixels to give a smoother picture. 'Professionally computer enhanced' images are processed this way.

A number of other frame manipulation commands are included in the module. The image can be flipped around the x and y axes, so rotations through 90 degrees are possible by a combination of the two. A *IMAGE command allows the new grabbed screen to be overlayed with whatever is present on screen by using AND, OR or EOR settings. Experimenting in mode 15 can lead to some very weird displays.

Overall picture

Once set up correctly, the podule and software worked well. As can be seen from the accompanying screens, the results are excellent and could almost be described as 'photographic' when viewed from normal television viewing range.

The podule will find good use in schools and colleges in such areas as Art, Video and Visual Research. Future releases of the software are to be made compatible with the AIM public domain software from Delft University, as well as Roger Wilson's Change FSI image-translator.

Home users with a bit of extra cash, might also like to put their Amiga-owning friends in their place and really show them what the Arc can do.

With the promise of further software, including a desktop version, the Pineapple colour digitiser looks to be one of the most professional products yet seen on the Archimedes.

The Pineapple colour digitiser costs £322 from Pineapple Software, 39 Brownlea Gardens, Seven Kings, Ilford, Essex 1G3 9NL. Tel. 01-599 1476.

Is *Pipedream3* up to its hype? DAVE FUTCHER explores the latest version of this wordprocessor with more

DREAM TIME

This is a package which totally blends text and numbers. Numerical tables can be incorporated in letters and reports, and sections of text added to spreadsheets. Even calculations within a database are possible.

Although the power of the Archimedes is essential to *Pipedream3*, its origins are deep in the early days of the BBC micro in the wordprocessor *View* and the spreadsheet *Viewsheet*. But the Archimedes *Pipedream3* takes applications to new heights with its full use of Risc OS.

Pipedream3 is not simply an update of Colton's original *Pipedream* package that ran under the Arthur operating system. This is nothing short of a total re-write of the original and although it is similar in function to its older Arc versions and current sister versions on other micros, the user interface of *Pipedream3* appears very different, as it is now totally Wimp controlled.

Risc OS banishes those pull-down menus. All of the resizing, scrolling and pointing operations are available, as are many drag and clicking operations.

The result is that *Pipedream3* operates much like *!Edit*. In addition to the selection by mouse of commands from menus, the program also has 'hot-key sequences'. These are similar to those on all other versions of *Pipedream*. However, for the Risc OS version, it was necessary for Colton to use the CTRL key rather than the ALT keys as the selection key, since the ALT key was changed by Acorn to be used with foreign character sets.

New concepts

Like its earlier Archimedes versions, *Pipedream3* offers a totally new concept in integrated software. All work with *Pipedream* is based on a spreadsheet style grid of rows and columns.

When the program is started, there is no ruler, instead you see the normal spreadsheet column headings appear across the top of the page and as text is entered line by line numbers down the screen (like spreadsheet row labels) appear.

This program has all the features of the most modern and powerful wordprocessor and spreadsheet available from mouse driven pop-down menus or CTRL sequences.

Pipedream3 can cope with as many documents all loaded at once as can be fitted into memory. Each appearing in its own window. Blocks of data can be simply copied and moved between windows and with more than one file loaded it is also possible to access slots in files in other windows. This will enable you to link several spreadsheets together to generate grand totals or create three-dimensional models.

With *Pipedream3* you have the choice of displaying your work on screen in the system font or in any other Risc OS font. So, the display can have different fonts in different sizes and these can be printed in graphics mode onto any printer with a Risc OS driver. Pictures created with *!Draw*, *!Paint* or other compatible applications can now be displayed within a *Pipedream3* document. Lingenuity's *Presenter2* fits in perfectly for graphs.

Pipedream3 incorporates the *Pipedream Spellcheck*, supplied as a separate package for the earlier versions of *Pipedream*. This comprises a dictionary of some 93,000 words – the largest supplied general dictionary for any Archimedes wordprocessor. User dictionaries are easy to create too and up to five at a time can be used.

Printing

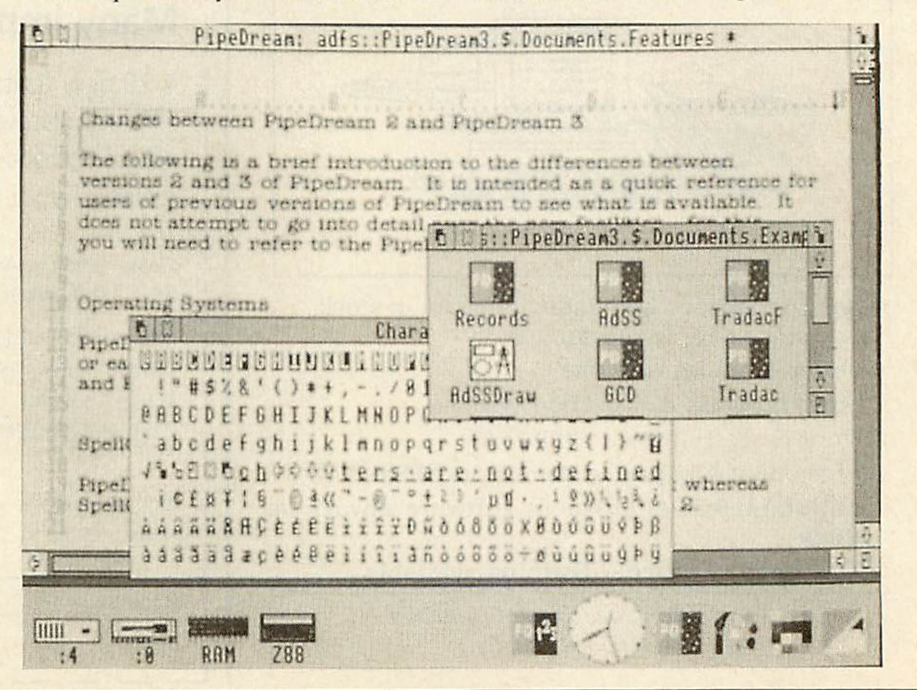
As well as its own printer driver system, *Pipedream3* can also use the Risc OS printer drivers supplied by Acorn.

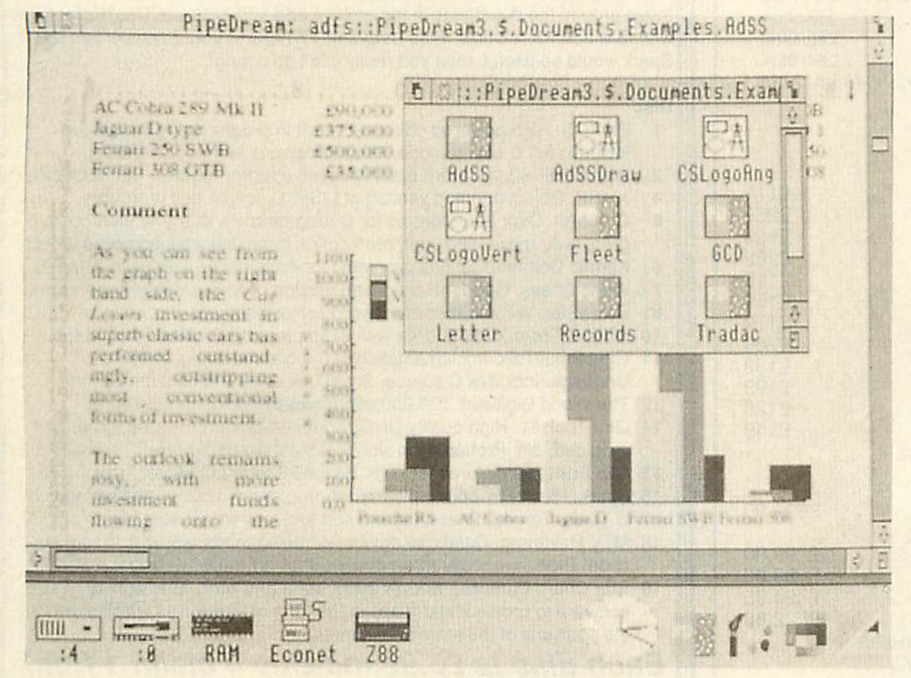
The *Pipedream* drivers are usually much faster than the Risc OS drivers because they just send out lines of characters, whereas the Risc OS drivers build up pages of bit-mapped graphics. But for documents containing graphs, pictures, or outline fonts you have to use the Risc OS drivers.

Extra options have been added to the print dialogue box to print multiple copies and for two-sided printing, reversing the order of parameters in headers and footers on even numbered (left-hand) pages and printing extra characters in the left margin of odd numbered (right-hand) pages.

Spreadsheet functions

When used as a spreadsheet, *Pipedream3* is more than capable. Any slot can contain numbers, formula and wordprocessed text.





It's fast, as it uses the floating point emulator to good effect and is capable of handling large spreadsheets. Colton quotes the spreadsheet area as half a billion each way but in reality it is limited by the memory of the machine long before that.

All the spreadsheet functions you would expect are there and more. In fact over 60 in total – seven mathematical, 13 trigonometrical, 11 statistical, 11 financial and 10 database functions.

As well as recalculating by row or column *Pipedream3* has 'natural recalculation'. This resolves problems of forward references where the spreadsheet might have to be recalculated more than once before all of the values are up to date.

Usefully rows and columns can be fixed while the rest of the sheet can be scrolled past the fixed slots. I particularly liked how the screen could be displayed with a faint grid which the printer driver will print out.

Database features

Pipedream3 offers a number of functions which enable it to operate as a database. The spreadsheet columns double as fields for the database, so fields can be wider than many 'traditional' databases allow. With the search and replace features of the wordprocessor, changes to files are easy.

Sorting is on a marked block and this can be numeric, alphabetic or chronological. The sort can be carried out on up to five key fields in a mixture of ascending and descending order. The sort also provides a file splitting feature.

I particularly like the possibilities of interchanging columns by using the block move command. It should also be possible to create a pictorial database by adding *!Draw* files or sprites to the text.

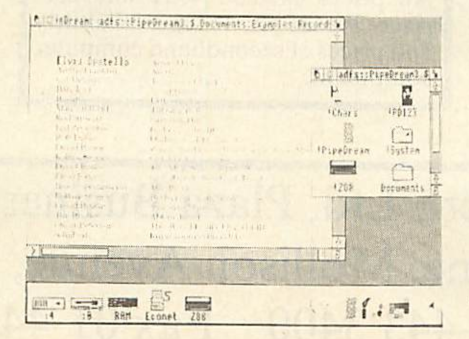
Formats

One of the greatest advantages of the *Pipedream* concept is the transfer of documents back and forth between the different versions of the program available on the Archimedes, IBM PC, Cambridge Z88 and the BBC micro.

Pipedream3 on the Arc or A3000 provides a Z88 filing system which makes the process even easier. This fits in well with the Risc OS philosophy too. The Z88 filer icon sits on the icon bar with the other filing system icons and provides a device viewer and directory viewers in a similar way to the drive icons.

Files can be dragged from directories in the Z88 straight into *Pipedream* and can be saved back again in a similar way. Files can also be saved to the Z88 by dragging them from other applications. *Pipedream3* can also handle files in many other formats. *Lotus 1-2-3* datafiles can be interchanged by the use of a separate application which allows more room for documents. Although *Lotus* macros are preserved, they are not usable within *Pipedream3*.

Files from *View* and *Viewsheet* on the Beeb can be accepted after conversion and even Archimedes *First Word Plus* documents can be loaded into *Pipedream3*.



It's perfect for upgrading from your old wordprocessor! Cleverly, Colton has provided a special save option that creates files suitable for loading into the Acorn's *Desktop Publisher*.

Installation

Unlike a growing number of Archimedes packages, *Pipedream3* can be legally backed up and a working disc created. A simple installation process backs up the disc and includes your name in the *Pipedream* program from then on.

For protection against piracy, each *Pipedream3* disc has a unique registration number identifying all working discs as having come from your master.

Room to move

Pipedream3 occupies over 460K of application space. So, in a 1Mb machine when run in mode 12, some 200K is available for text – about 28,000 words and normally plenty of room indeed.

Nevertheless, the program employs efficient data compaction and more sparse matrix techniques enabling larger files to be loaded into the same amount of memory.

The actual improvement will depend upon the data but, in general, the sparser the file (the more blank spreadsheet slots there are) the greater the improvement. Additionally *Pipedream3* communicates intelligently with Risc OS to use only the amount of memory it needs at any time, correctly giving memory back to the system when it is no longer needed.

Conclusions

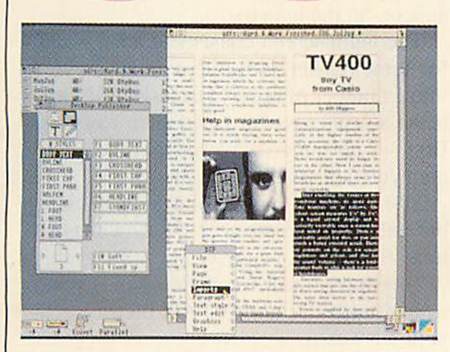
Colton is to be congratulated on the documentation provided with *Pipedream3*. The wire bound A5 book lies flat so it's practical to use and covers everything with considerable clarity in three sections – Getting started, Using *Pipedream* and Reference. Usefully the distribution disc contains a number of sample files so that the full features available can be reviewed easily.

As a collection of individual applications it excels. But *Pipedream3* is much more than this. It provides a truly integrated package – you can work with text, lists, numbers and calculations on the screen all at once. Running under Risc OS it provides a real windowed, multi-tasking application that is easy to use but with considerable power and speed.

Pipedream3 *costs £169 from Colton Software, Broadway House, 149-151 St Neots Road, Hardwick, Cambridge CB3 7QJ. Tel: (0954) 211472.*

Owners of the older version without the Spellchecker can upgrade to Pipedream3 *for £65.* Pipedream *with the* Spellchecker *can be upgraded for £30.*

COVER TO COVER



Acorn DTP **by Anne Rooney, from Emerald Publishing, PO Box 324, Cambridge CB1 3HB £14.95. Examples disc £3.95**

Complex software often attracts books whose aim is to demystify. Sometimes they rehash the manual, the better ones supplement it and simplify the subject.

There is a suspicion that Anne Rooney's *Acorn DTP* is the manual for those who have stolen a copy of Acorn's desktop publishing software but not bothered to photocopy the real manual. The first chapter is a step-by-mouse-step guide to getting *ADP* running on your Arc and it duplicates exactly the information given in Acorn's own manual.

The book has an uncritical approach to *ADP*. It glosses over its inability to handle leading correctly. In suggesting a wordprocessor to complement *ADP*, *First Word Plus* is recommended without explaining that current versions don't work properly on the Risc OS desktop without modification (the new Risc OS version does).

The early sections add nothing to badly-explained parts of the original manual and offer little useful basic advice.

However, by chapter five, it does start to offer useful snippets, describing a workaround for importing graphics and keeping the aspect ratio fixed. There's similar good advice on creating ruled tables with frame borders.

The heart of the book is a long section of example documents, posters, memos, books, leaflets and so on, many of which are included on an examples disc. All of these are workable and the style sheet files on the disc may be useful.

The troubleshooting chapter at the back is excellent – it reminded me why I couldn't import a story from *!Edit* into a frame that had previously held a headline.

The book itself was typeset using *ADP* – and sadly it shows. The page layout and design style lack coherence, with too many bullet points and an ill-judged range of subheading styles. It's also peppered with an uncomfortable number of spelling errors. But it shows that it is possible.

The real problem with this volume is too much cost for too little value. The software has a good manual to start with, and Anne Rooney adds too little detail to it to be worth the asking price.

Graham Bell

Procedural Elements of Computer Graphics **by David F Rodgers, from McGraw-Hill International £11.95**

For a long time I have been looking for a book which details all recent graphics techniques, gives examples and even algorithms. A few hopefuls have appeared but, up to now, nothing definitive.

If you are interested in computer graphics and need a book which covers it all, then blast down to the nearest bookshop and order this – it's a goldmine. Tony Cheal, who wrote the solid-modeller *Euclid*, uses the book as his reference material.

The author has succeeded in writing a book which is instructional, informative and fun to read. Computer graphics is now a huge subject which encompasses many methods and techniques, yet *PECG* lists most of them with their corresponding theory and sometimes algorithms. The diagrams are always clear and well-drawn.

The author forces his way through grunt topics like input devices (mice, lightpens and so on) and tiptoes through delicate topics like aliasing, shading and colour.

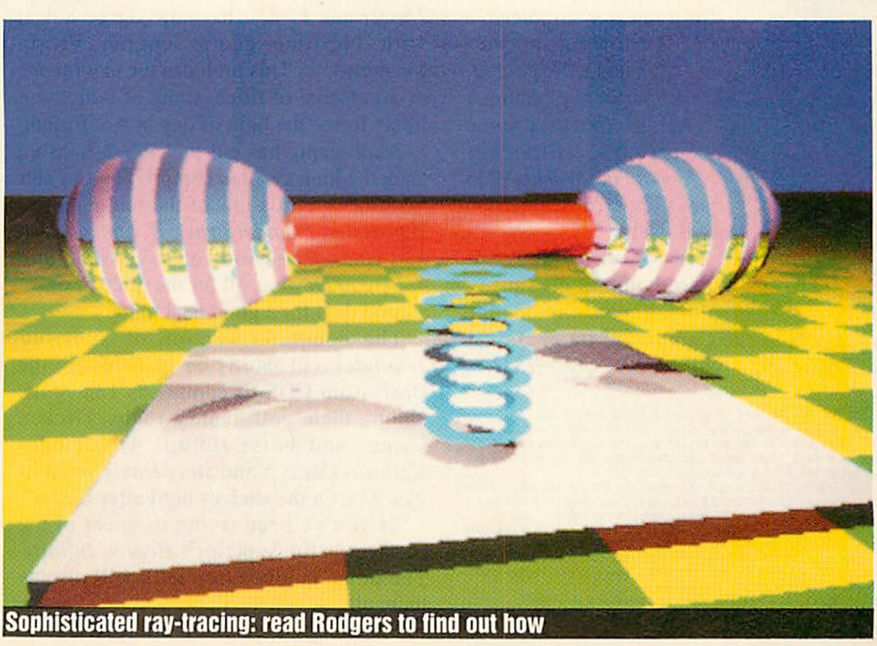
He also covers (with algorithms and worked examples) rendering, texturing, ray tracing, colour and more. Each chapter has a list of references and at the end of the book there is a suite of questions.

If you can work your way through these, then it is guaranteed that you will have the tools and ability to create the most astounding graphics.

Of course, with any study-type book it is up to the reader to get practical – to practice and understand the theory. However, the ease with which this is done depends solely on the content of the book.

And the content of this book makes it unquestionably worth buying!

Richard J Browning



Sophisticated ray-tracing: read Rodgers to find out how

GAME

In days of old when the land was cold and small furry bunnies could be seen among the daffodils, when the Easter bunny meant more than the chocolate eggs, it wasn't possible to hop along to your dealer for a taste of the latest games releases. Things is different now.

The Fourth Dimension is preparing the greatest number of new releases from any software house. The month of May should see a version of *E-Type* for the Beeb and Electron (in enhanced form on the Master).

In the Archimedes Easter egg is *Liberator*, the first game to make use of 4D's 'advanced 3D plotting routines'. Set on a planet in space, the idea is to fly around from city to city, touring each one checking out the 'in' places to be, all in fine graphic detail. Priced at £29.95 I'm assured it's worth every penny.

Our spies have brought back news of a special emulator for the Arc. It works like the 6502 emulator supplied on the Welcome disc but has the ability to run 'illegal' code. This implies games such as *Elite* and *Exile* and possibly even *Repton Infinity*, among others, will run. Watch out for it in early summer.

Following successful sales of *Ricochet*, Superior is planning a set of extra screens entitled *Ricochet Around the World*. Who says history doesn't repeat itself?

In mid-March the Arc's newest software house is organising an Archimedes software event. Among the attendees to the Cambridge International Software show will be *BBC Acorn User*, along with Minerva, Alien Images and possibly Superior, all presenting new games. CIS itself will be showing its latest – *Cybol II* – plus a few Mac conversions.

Magnetic Scrolls – the force behind brilliant adventures such as *Corruption*, *Jinxter* and *Fish!* – has now signed a deal with big-time games engine Virgin Mastertronic. This preludes the emergence of an arsenal of titles, some of which are likely to see the light of day in Arc format.

Audiogenic has cut the ribbon holding back the long awaited compilation of Peter Scott/Gary Partis hits of the mid-eighties. It contains *ThunderStruck II*, *Omega Orb* and revised versions of *Psycastria* and *Sphere of Destiny*, all for the price of one – a good deal for a good deal there.

The computer version of *Sporting Triangles* will shortly be available for the Beeb from CDS. It comprises 12 events, among them golf, tennis, rugby, cricket, soccer and horse-riding. Archimedes *Collosus Chess X* and *Steve Davis Snooker* won't be on the shelves until after Easter.

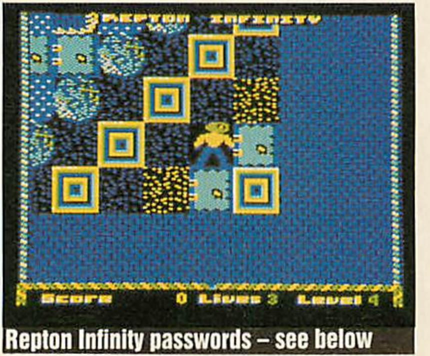
If you've been trying to guess at the passwords for Superior's *Repton Infinity*. The program given (see left), will display them all.

Sam Greenhill

```
10 MODE 7:FOR I%=Ø TO 2 STEP 2:P%=&9ØØ:[OPT I%
20 .pass:LDX #Ø:.dloop:TXA:CLC:ADC #5Ø:JSR &FFEE:LDA #41:JSR &FFEE:LDA #32:JSR &FFEE:TXA:PHA:JSR calcpass:LDY #Ø:.ploop:LDA bytes8,Y:JSR &FFEE:INY:CPY #8:BNE ploop:JSR &FFE7:PLA:TAX:INX:CPX #3:BNE dloop:RTS
30 .calcpass:ASL A:CLC:ADC #&5E:TAX:STX whichtwo+2:INX:STX whichtwo+5:LDA #Ø:LDY #8:.clrpass:STA bytes8-1,Y:DEY:BNE clrpass:.passloop:LDX #7:.passloop2:LDA bytes8,X
40 .whichtwo:EOR &BB8Ø,Y:EOR &CC6Ø,Y:STA bytes8,X:INY:DEX:BPL passloop2:CPY #Ø:BNE passloop:LDX #7
50 .toascii:LDA bytes8,X:.subasc:SEC:SBC #26:CMP #26:BCS subasc:ADC #65:STA bytes8,X:DEX:BPL toascii:RTS:.bytes5:EQUD Ø:EQUD Ø:.bytes8:EQUD Ø:EQUD Ø
60 ]NEXT:PRINT"Repton Infinity password printer"
70 REPEAT:INPUT'"File name M."n$':OSCLI("Load M."+n$+" 5E70"):CALL pass:UNTILØ
```



E-Type – soon on the Beeb



Repton Infinity passwords – see below

Cross Star

David Pilling Software
Arc/A3000 £5.99

According to the blurb, *Cross Star* is a Wimp based crossword solver that makes solving crosswords easy. The question is, of course: is it and does it?

Although the program does use the Arc Wimp system, it does not make use of the desktop environment, it does not even sit as an icon on the icon bar.

The main screen consists of a large and, for some reason, movable window divided into a number of areas. The largest of these is the actual crossword grid, here you must first set up the crossword 'template' and then you can start solving the puzzle.

You can alter the size of grid by clicking but only a 16x16 area can be shown at one time. Scroll bars pan over the entire grid.

To enter solutions, the cursor is positioned with the mouse, you then type in your answers.

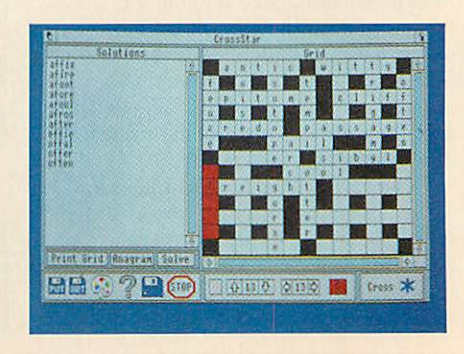
When you get stumped by a clue, the 'Solve' icon will produce a list of possible solutions from a dictionary of over 100,000 words in the second window. Pointing to any of these will automatically insert it in the grid.

Cross Star will also solve anagrams, although you'll have to find a space on the grid to type in the 'puzzle' word. Further icons load and save grids, print them out (in a very basic form) and clear them.

Unfortunately, there is no provision for numbering the grid, or entering the clues, so you still have to sit clutching the original paper crossword ticking off the clues.

Personally, I don't think that *Cross Star* provides enough features to really help you with crosswords. For my money, I would rather stick to *Spellmaster's* wildcarded word search, which is all *Cross Star* really does well anyway.

David Lawrence



SHOW

The Last Ninja II

Superior Software Tel: (0652) 58585
BBC cassette £9.95, disc £11.95, Compact £14.95, Electron £9.95

What can I say? The graphics are similar, the sound is similar, the plot is too and so are the puzzles! *Ninja II*, *Ninja I* – what's the difference? Two things: the name and the place. The bloke in the black suit meets the suits of New York plus the cops and the rough and tumble of the underworld, along with drugs, credit cards and computers.

Strangely, some drunken fool has left a bunch of shrunken stars lying about in Central Park and these can be collected and used to persuade pushy cops to step down (or lie down!).

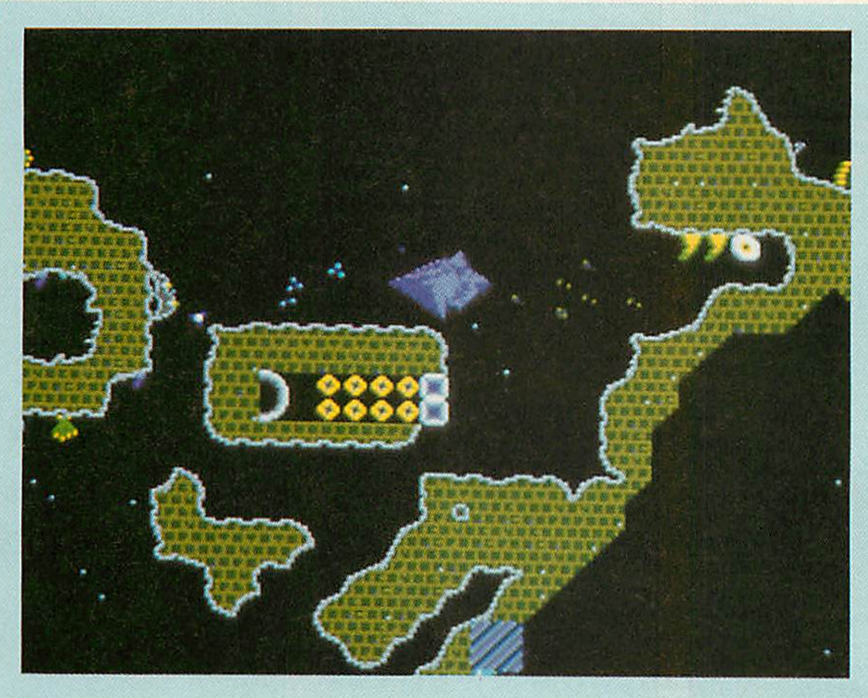


The game is structured as six levels, each with its own map and graphics in much the same way as *Ninja I*. It doesn't take too long to familiarise yourself with an area but not too quickly either – just right. The most serious problem is the lack of a 'save game' option. When you're trying to master the final level it is tedious to have to work through the first five.

The diagonal layout of each screen has survived the journey to the Big Apple but so has the crooked walk the Ninja seems to have in some places. This sequel is neither better nor worse than it's predecessor.

This makes it one of the most unoriginal games, which is probably why it will sell well! If you thought *Ninja I* was good, this takes a good thing further – in the same direction, but who cares?

Sam Greenhill



Caverns

Minerva Software Tel: (0392) 437756
Arc/A3000 £17.95

Those of you who remember the first Repton game will be pleased to hear the author responsible has emerged with yet another gem.

Genius Tim Tyler has taken the best elements from several games and produced a great shoot-em-up/arcade adventure for the Archimedes.

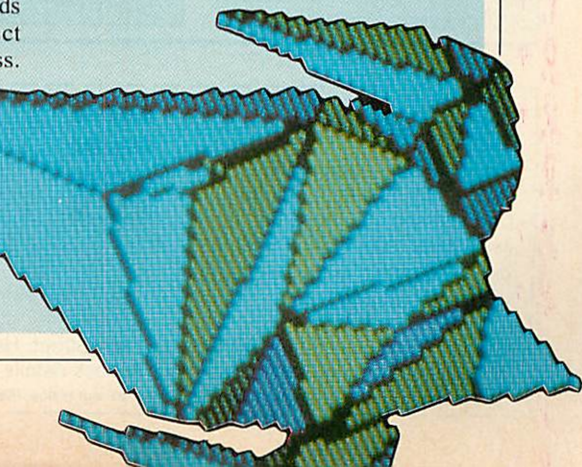
Loosely based on the classic *Thrust*, *Caverns* goes one stage further and adds the complication of having to collect objects and solve puzzles to progress. This all happens under the (constant) force of gravity and therefore requires a lot of skill and patience to succeed.

The first problem is having to collect a rope, and then carry a boulder from one place to another. Sounds easy enough, I hear you cry, but wait. Don't forget the boulder will add more weight, and once it starts to swing ...

Level one is close on impossible to finish, without even mentioning the other 20 or so levels. Fortunately there is a password system, although you only get a password once you've finished a level. The kind people at Minerva gave me the full list of passwords (no, I'm not telling!) and I can confirm your worst fears. Things get worse (in the nicest possible way of course!).

The graphics in *Caverns* are pretty smooth although there is an air of 8-bitness about them. The loading page appeared to promise solid, shaded 3D-graphics, although things fell flat (sic) in the game. The sound is below par and I would have expected Minerva to do a lot better. Barring that though, the game is challenging, there's lots to do, and should keep you coming back for that all important extra go.

Rob Miller





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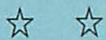
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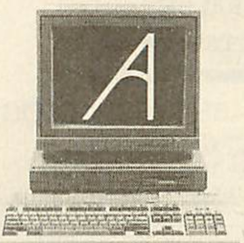
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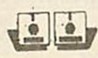
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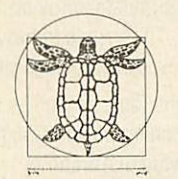




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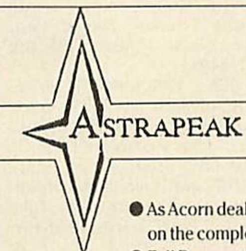
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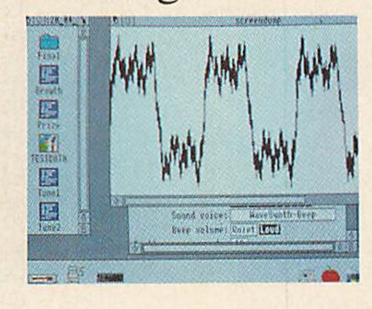
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TOMATO SOURCE

Down on the farm, the A3000 calls the tune. **MALCOLM BROWN** digs a little





The thought of serenading your salad is a foolish notion to most but to Allen Broods it's all serious stuff. To Allen, music plays an important part in growing plants.

Allen owns a successful market garden farm in Norfolk and, even more than most small businessmen, he spends his spare time researching ways of increasing his growth potential.

'I started just playing with different hours of sunlight, temperatures, watering patterns and such,' he says, 'using small corners of the farm glasshouses. But this got in the way with the business and the lads kept laughing at me, so I installed five of these smaller greenhouses especially for my experiments'.

Much to the amusement of his fellow workers, today Allen's 'experiments' mean tunes for the tomatoes.

'It's quite an old idea actually,' says Allen defensively. 'The Victorians were keen market gardeners and experimented with growing to music. There's even some schools of thought which give the Romans as the first lot into all this – there's some frescoes in Pompeii or somewhere showing musicians playing to the crops'.

Whatever the roots of the idea, Allen is certainly bringing it right up to date.

'I started with just a tape recorder. I chose the tomatoes because the fruit develops so quickly, you get a good idea of progress in a couple of weeks. After a couple of season's experiments with different music, I discovered that rhythmical but not aggressive tunes did best – waltzes, classical dance and ballet'.

Unlike previous investigators, Allen did not stop there. 'Since it seemed we were definitely getting somewhere, I decided some further investment was called for.

'I was already trying to measure the response of the plants using a BBC micro to sense and record the results so I added a Music 5000 to provide the sounds.

'This wasn't really the best arrangement. Although the sounds produced with the Music 5000 were fine, using the computer to sense and record the plants' growth was not practical while the music was playing – not for someone of my programming abilities anyway! So I gave up with computer sounds for a while and went back to tape'.

When the Archimedes came along, Allen saw the potential immediately. With the advent of the A3000, he has been able to equip each of his experimental greenhouses with its own computer sound generator and response logging computer.

'Being able to produce complex sounds with one task and to run the data gathering and logging program in another makes life very simple,' he cheerfully relates. 'The A3000 with a small amplifier and speakers can produce all the sounds I need and it's able to record the results'.

The sounds which issue from the computers defy description. In some of the greenhouses there are noises Stockhausen would be proud of. In others it's more like the opening theme of *Dr Who* set for a string quartet.

Allen is clearly pleased with his efforts. 'I'm getting closer now to narrowing down exactly what it is that makes them grow,' he says. 'But it's a slow business. It took me over four years to realise they don't like to be played to at night!'

The results in some of the greenhouses speak for themselves. 'It's not all down to the music,' Allen admits, 'the remarkably mild winter we've had and the masses of sunshine helps. Still, you've got to admit I am growing some beauties!'

Beauties they certainly are. In greenhouse D, where the tomato plants are serenaded with a sort of pulsating astral choir, they are decked with enormous fruit. 'And they taste good too,' Allen assures us.

Allen is now working on direct feedback techniques. 'The idea is to let the computer itself control the tonal qualities of the sounds,' he says, 'and to alter them in response to the tomato's growth'.

It has taken Allen some tough programming to get this far. He has produced his own specialist sound generator (and he's experimenting with sampled sounds now, too) and data gathering software.

The sensors and interface hardware is home made too, concocted with the help of Allen's brother-in-law. 'I've promised him a share of the profits when this goes commercial,' says Allen.

That's going to take some more research but when Allen's completely happy with the tomatoes' response, the big glasshouse will be kitted out with the PA system and sensors. Then Allen will be ready to take over the tomato world.

'When that's worked out,' he beams, 'we'll see who has the last laugh!'

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